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science and engineering personnel: a national overview

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science and engineering personnel: a national overview

author: r. keith wilkinson

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foreword

This report presents a comprehensive look at the status of U.S. scientific and technological efforts as they relate to the employment and other characteristics of science and engineering (S/E) personnel, and provides a framework for analyzing issues relating to these personnel.

Chapter III of this report, "The Dynamics of S/E Labor Markets," presents for the first time a numerical illustration and analysis of S/E personnel flows into and out of the S/E workforce. Also featured in this chapter is new information on industrial demand for S/E personnel, including a discussion on projected industrial requirements for scientists and engineers.

This publication is a useful complement to the *National Patterns of R&D Resources* and the National Science Board's biennial *Science & Engineering Indicators* series, both developed by the Division of Science Resources Studies. Comments and suggestions, especially concerning the new material presented in chapter III, are invited so that future volumes will continue to reflect the information needs of policymakers and others concerned with U.S. efforts in, and the human resources of, science and technology.

William L. Stewart
Director
Division of Sciences Resources Studies

January 1990

acknowledgments

This report was prepared in the Division of Science Resources Studies (SRS) by R. Keith Wilkinson, Science Resources Analyst, Employment Studies Group (ESG), under the general direction of Joel L. Barries, Study Director, ESG. Primary statistical support was provided by Theodosia L. Jacobs, Statistical Assistant, Special Analytical Studies Section. Secretarial and other statistical support services were provided by Julia H. Harriston, Vellamo H. Lahti, Virginia D'Ambrosio, Tanya R. Gore, and Michelle R. Edwards of the SRS Administrative Support Group under the direction of Joanne P. Streeter. Guidance in editorial and production matters was provided by Lionel C. Bischoff, Millicent V. Gough, and Elizabeth J. Michael, Office of the Division Director, SRS. Nita Congress provided other professional editing services; Patricia D. Hughes of NSF's Printing Services Branch coordinated production of the document.

Overall guidance was provided by Leonard L. Lederman, Head, Special Analytical Studies Section; William L. Stewart, Director, SRS; and F. Karl Willenbrock, Assistant Director, Scientific, Technological, and International Affairs.

notes

- Concepts and definitions underlying much of the data in this report, as well as major data sources, are discussed in appendix A.
- Many of the statistics presented are subject to both sampling and nonsampling error. The specific statistical limitations of the data are described in appendix A.
- The information on characteristics of U.S. scientists and engineers is primarily based on data from the National Science Foundation's (NSF's) Postcensal and Experienced Sample Surveys for the seventies and eighties. Each decade, NSF uses the decennial census to develop a baseline of data on scientists and engineers for these surveys. Since there are differences in the data concepts and definitions used in each decennial census, the data presented in this report for years 1976-88 are not entirely comparable with estimates from previous decades. See appendix A for more information.

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highlights

employment trends

- Employment of those in S/E jobs rose substantially over the 1976-86 decade. Science employment nearly doubled during this time, while employment of engineers increased by over 75 percent. Overall, the S/E workforce grew by 6.3 percent per year during this period; this was three times as fast as total U.S. employment. As a result of this differential, the proportion of the workforce devoted to science and engineering grew from 2.4 percent in 1976 to 3.6 percent in 1986.

- Almost one-quarter of all scientists and one-tenth of all engineers employed in the United States in 1986 were working in non-S/E activities. Within science fields, social scientists and computer specialists were the most likely to report non-S/E employment, while mechanical and electrical/electronics engineers were the most probable among engineering subfields.

- Approximately 1.7 million scientists and 2.2 million engineers were employed in S/E jobs in 1986. Almost one-half of scientists were concentrated in two fields; the same was true for engineers. Among scientists, 46 percent were employed as either computer specialists or life scientists; for engineers, 44 percent were either electrical/electronics or mechanical engineers.

- Between 1984 and 1986, employment in science occupations increased at an annual rate more than twice that for engineers, 9.3 percent versus 4.3 percent. The more rapid growth among scientists resulted from above average growth in two fields: computer specialties (13 percent per year) and the social sciences (12 percent per year). Environmental and physical scientists experienced the slowest growth among scientists (4 percent and 6 percent, respectively). Among engineering subfields, electrical/electronics and aeronautical/astronautical engineers rose the most rapidly—7 percent each annually—while chemical engineers reported the slowest growth at less than 2 percent per year.

- Scientists at the doctoral level outnumbered engineers by about five to one in 1987 (351,000 versus 68,000). Over the 1977-87 period, total employment growth for both Ph.D. scientists and engineers averaged less than 4 percent per year. Among the sciences, computer specialties was the fastest growing field of employment with annual growth of almost 12 percent per year. In engineering, aeronautical/astronautical engineering was the fastest growing subfield of employment with annual growth of slightly less than 10 percent per year.

s/t activities

- Patterns in the primary work activities of scientists and engineers in S/E jobs are direct indicators of the character of U.S. science and technology (S/T) work. In 1986, research and development (R&D) was the principal work activity of 27 percent of the Nation's scientists and 34 percent of its engineers. An additional 9 percent of scientists and 10 percent of engineers cited R&D management as their primary activity.

- Work activities vary widely by S/E field. In 1986, scientists were more likely than engineers to be engaged either in teaching activities (17 percent versus 2 percent) or in reporting, statistical work, and computing (16 percent versus 5 percent). In contrast, a greater percentage of engineers than scientists reported production and related activities as their major work area, 18 percent versus less than 7 percent.

sector of employment

- Over the 1976-86 decade, the relative distribution of the S/E workforce (scientists and engineers engaged in S/E activities) became more concentrated in business and industry, with its share of total S/E employment increasing from 62 percent to 66 percent. During this period, more than 70 percent of the 1.8-million person S/E employment growth in the United States occurred in this sector. Science employment within industry increased at an average annual rate of 8.3 percent over this period; this was over one-half the total U.S. increase in scientists. Engineers in business and industry grew by 6.5 percent annually, accounting for almost 90 percent of the total U.S. employment growth in this field.

- Over the 1980-88 period, the concentration of private sector S/E jobs shifted gradually from goods-producing industries to services-producing industries, with the proportion in the latter sector increasing from 38 percent in 1980 to an estimated 43 percent in 1988. The increase during this period can be attributed both to a faster rate of employment growth for S/E personnel in services-producing industries, and to the sector's general economic and employment growth as reflected in its total employment expansion. Overall, employment in services-producing industries grew at an average annual rate of 3.2 percent between 1980 and 1988; the number of S/E jobs increased on average by 5.8 percent.

- Approximately 29 percent of all scientists and 4 percent of all engineers engaged in S/E activities in the United States in 1986 were employed in educational institutions, primarily universities and colleges. Over the 1976-86 decade, science employment within academia increased at an average annual rate of almost 8 percent, while employment of engineers rose at an average annual rate of over 9 percent per year. Most of this growth occurred between 1980 and 1986. Science employment in this sector increased at an average annual rate of more than 10 percent during this time, while engineering employment rose by 15 percent per year. For the 1976-80 period, comparable growth rates were 3.6 percent for scientists and 1.0 percent for engineers.

- Federal S/E employment growth outpaced that in the other two sectors between 1984 and 1986, growing at an annual rate of 7.2 percent, compared to 5.8 percent in industry and 7.0 percent in educational institutions. This growth was attributed primarily to an increase in defense R&D spending and a relaxation of the hiring restraints imposed on Federal agencies in the early eighties.

- S/E doctorate-holders were concentrated primarily in educational institutions in 1987, although the proportion of doctoral scientists employed in this sector has declined steadily since the late 1970s. In 1977, 62 percent of those with science doctorates were employed by educational institutions; by 1987, the proportion had declined to 55 percent. The percentage of doctoral engineers employed in this sector remained at about 35 percent throughout the decade. In business and industry, the proportion of Ph.D. scientists employed in this sector increased from 20 percent to 27 percent between 1977 and 1987, and the percentage of doctoral engineers rose from 51 percent to 55 percent.

women and minorities

- Women scientists and engineers represented about 13 percent of the S/E workforce in 1986, up from 8 percent in 1976. As a proportion of the total workforce, however, only about 1 percent of all employed women were working in S/E jobs in 1986, compared to almost 6 percent of all employed men. By field, women accounted for a much larger share of the science workforce than of the engineering: 26 percent versus 4 percent.

- Blacks continued to be underrepresented in science and engineering, accounting for only 2.2 percent of the S/E workforce in 1986. In the general workforce, blacks represented 10 percent of total U.S. employment and almost 7 percent of those in professional and related occupations. In contrast, Asians, although less than 2 percent of the U.S. labor force and only 3 percent of those in professional fields, represented almost 6 percent of all scientists and engineers. Native American scientists and engineers represented somewhat less than 1 percent of total S/E employment, roughly similar to their participation in the overall U.S. labor force.

- Hispanics remain underrepresented in the S/E workforce, accounting for approximately 2.1 percent of the scientists and engineers employed in 1986. In comparison, roughly 6.6 percent of all employed persons, and 3.3 percent of those in professional and related occupations, were of Hispanic origin.

labor market indicators

- Labor market indicators suggest that there was a favorable job market for scientists and engineers in most S/E fields in 1986. Approximately 95 percent of the S/E population was in the labor force at that time, with scientists and engineers equally likely to be working or seeking employment. This participation rate is higher than the 82-percent rate for the general population with 4 or more years of college.

- Unemployment rates for scientists and engineers lie well below those for the general workforce. In 1986, unemployment rates averaged 1.9 percent for scientists and 1.2 percent for engineers, down from 4.0 percent and 2.0 percent, respectively, in 1976. In comparison, the unemployment rate for all professional and technical workers was 2.0 percent in 1986, and 7.2 percent for the total workforce.

projected s/e demand

- Over the 1988-2000 period, the number of jobs for scientists and engineers in U.S. private industry is expected to increase by almost 600,000; three-fifths of these new jobs will be located in the services-producing sector. The faster creation of S/E jobs in this continues a trend observed between 1980 and 1988. Overall, the proportion of industry science jobs in the services-producing sector is expected to increase from 62 percent in 1988 to 68 percent by the year 2000; the percentage of engineering jobs would go from 35 percent to 36 percent during this period.

s/e degree production

- There were approximately 247,000 science and 77,000 engineering baccalaureates awarded in the United States in 1986, reflecting increases of 10 percent and 30 percent, respectively, since 1980. The distribution of S/E bachelor's degrees changed significantly during this period, favoring production of degrees in engineering and the mathematical sciences, including computer science; degree production in the life and social sciences showed the greatest declines.
- More than 62,500 students were graduated with master's degrees in S/E fields (41,200 in science fields and 21,300 in engineering) in 1986, an all- time high. Roughly 16,100 science doctorates and 4,200 engineering doctorates were conferred in 1988, representing 61 percent of all doctorate degrees.
- The number of S/E doctoral degrees awarded in the United States has increased almost annually since 1978, although the number of U.S. citizens receiving S/E doctorates has declined somewhat during this period. Foreign students received 49 percent of all doctorates in engineering in 1988 and 27 percent in the sciences, compared to 35 percent and 15 percent, respectively, in 1978.

chapter I

utilization patterns of scientists and engineers

current employment and trends

During the last decade, employment in science and engineering has grown more rapidly than has either total U.S. employment or overall economic activity. This growth reflects substantial shifts in national activity patterns toward those related to science and technology. Almost all S/E occupations have shared in this growth, particularly computer specialists. The proportion of the Nation's scientists and engineers[1] employed in industry and academia has continued to increase, while the percentage working in the Federal Government and other sectors has declined.

non-s/e employment

Not all of those who are scientists and engineers by virtue of their education and experience are actually employed in S/E jobs. For a variety of reasons—including such voluntary reasons as better pay, promotions, or location preference—some scientists and engineers hold jobs outside their own or related S/E degree fields. Scientists are more likely to hold such non-S/E positions. Of the approximately 2.2 million scientists employed in 1986, 23 percent (510,000) reported that they held

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[1] Information on the demographic, educational, and employment characteristics of scientists and engineers is generated using the Science and Engineering Tabulating Model. This model combines data from two surveys of the Scientific and Technical Personnel Data System: (1) the Experienced Sample of Scientists and Engineers, which collects data on a biennial basis from individuals who were in the S/E population at the time of the 1980 census; and (2) the Survey of Recent Science and Engineering Graduates, which collects information on those persons who have earned degrees in S/E fields since 1980.

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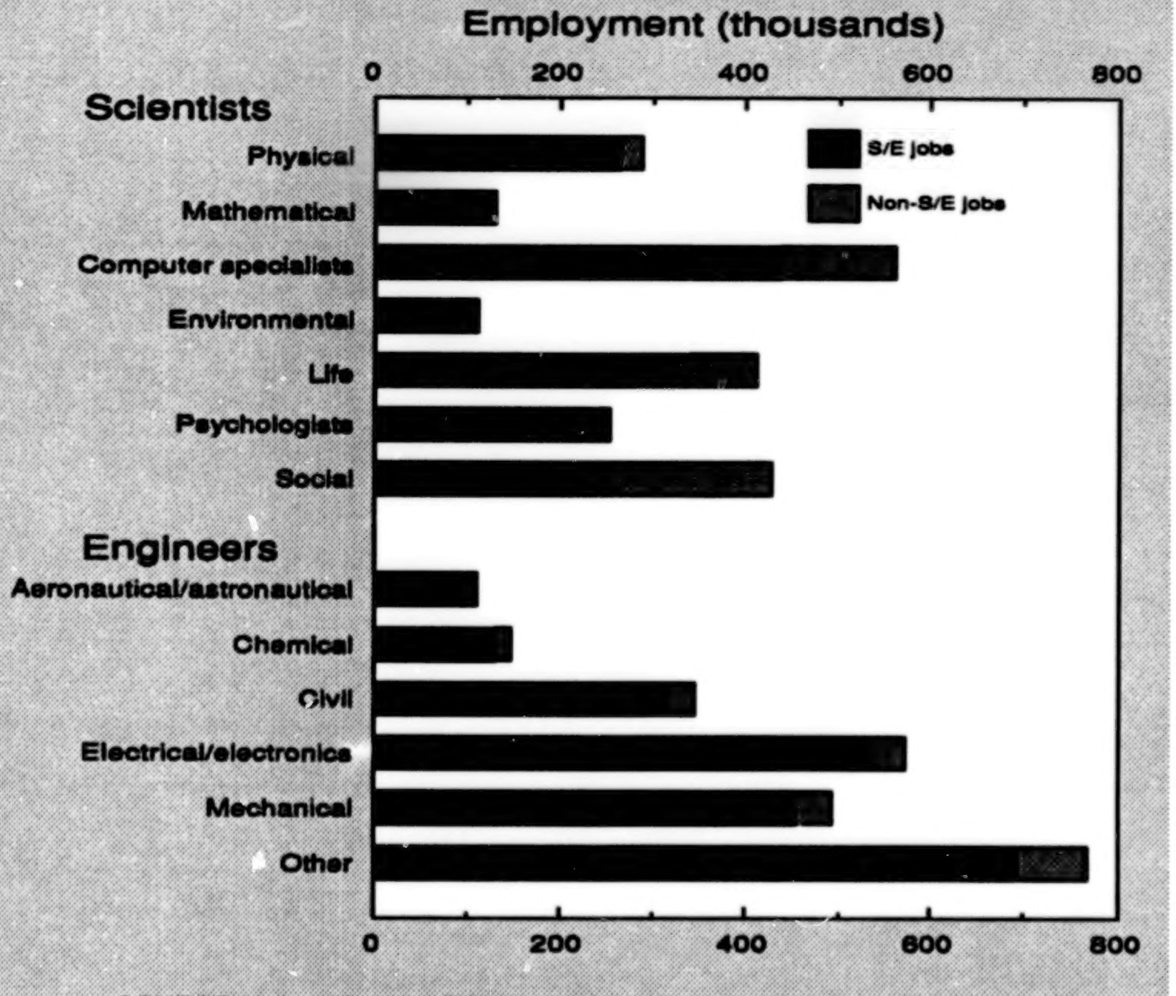
jobs outside of science and engineering. In contrast, only 8 percent (200,000) of the 2.4 million employed engineers worked in non-S/E jobs.

Of those scientists who reported non-S/E employment in 1986, almost one-third (168,000) were social scientists and approximately one-quarter (125,000) were computer specialists (chart 1). Of engineers employed in non-S/E activities at that time, almost two-fifths were either mechanical engineers (39,000) or electrical/electronics engineers. Employment of scientists and engineers in non-S/E jobs does not necessarily imply under-utilization, since employees' S/E training and education may be prerequisites for, or provide valuable inputs to, their work.

s/e employment by field

S/E employment[2] growth varied between scientists and engineers over the 1976-86 decade. Science employment rose by nearly 100 percent during this time, while employment of engineers increased by over 75 percent (chart 2). Overall, the S/E workforce grew by 6.3 percent per year during this period, reaching almost 4 million. U.S. employment, in contrast, increased by only 2.1 percent annually.[3] Consequently, the proportion of the workforce

Chart 1. Employment status of scientists and engineers by field: 1986



SOURCE: National Science Foundation, SRS; tables B-2,B-3.

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[2] Includes only those scientists and engineers employed in S/E jobs, unless otherwise indicated.

[3] Council of Economic Advisors, *Economic Report of the President, 1987* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, (February 1987), p. 282.

employed in science and engineering[4] rose from 2.4 percent in 1976 to 3.6 percent in 1986 (chart 3). In addition, real gross national product (GNP)—an indicator of overall economic activity—increased at an annual rate of only 2.7 percent over the decade.[5]

Some of the rapid increase in the employment of scientists and engineers is due to general workforce trends. Most of this growth, however, reflects the relatively greater utilization of S/E personnel within the economy—presumably because of greater technological and scientific sophistication of products, production processes, and services; increased government expenditures for defense and other programs requiring significant inputs of S/E talent; and other factors.

In 1986, approximately 1.7 million scientists and 2.2 million engineers were employed in S/E activities in the United States. Almost one-half

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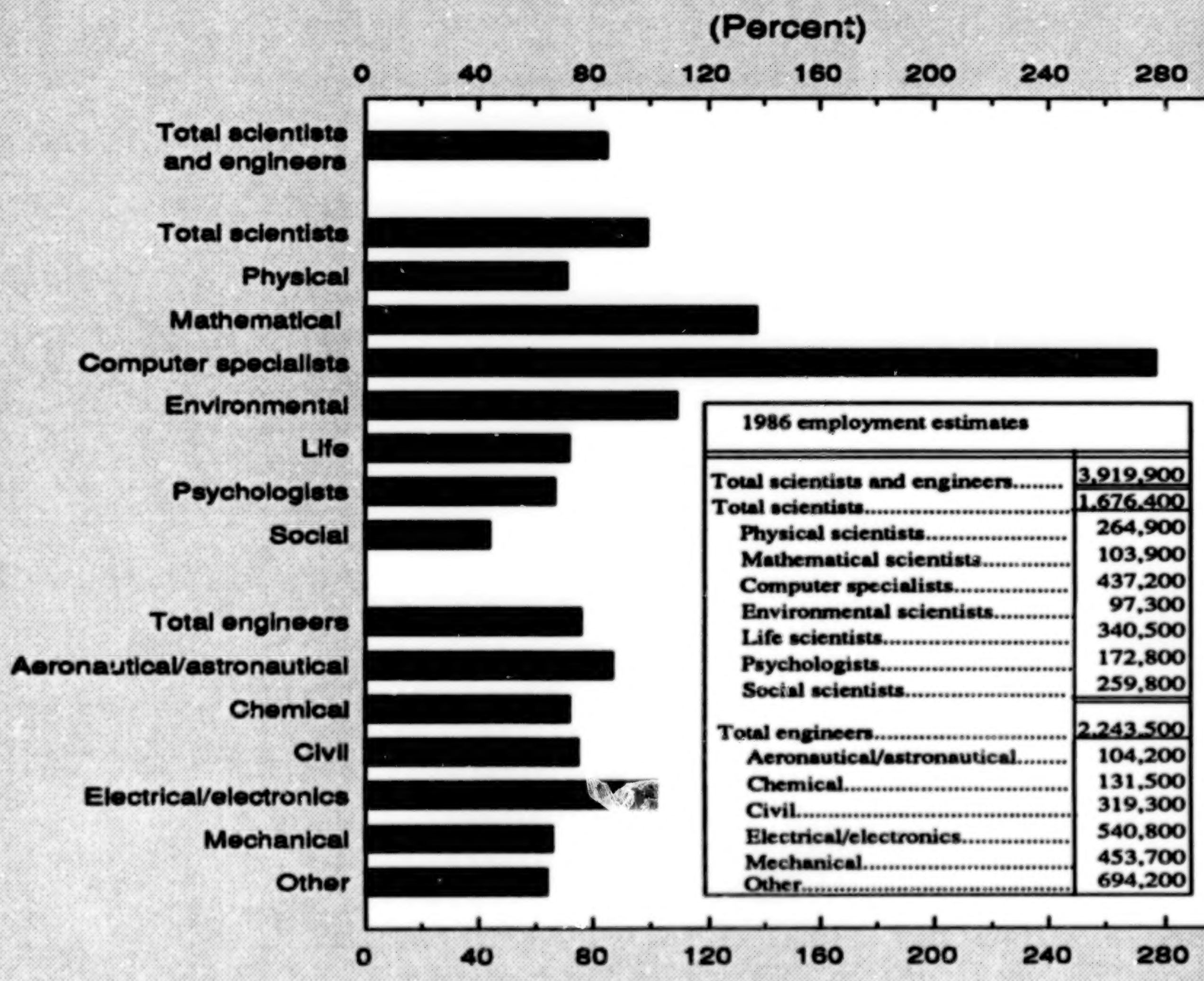
[4] Refers only to scientists and engineers employed in S/E jobs. Technician and other occupational groups which may be engaged in S/E-type work are not included.

[5] Council of Economic Advisors, op. cit., p.246.

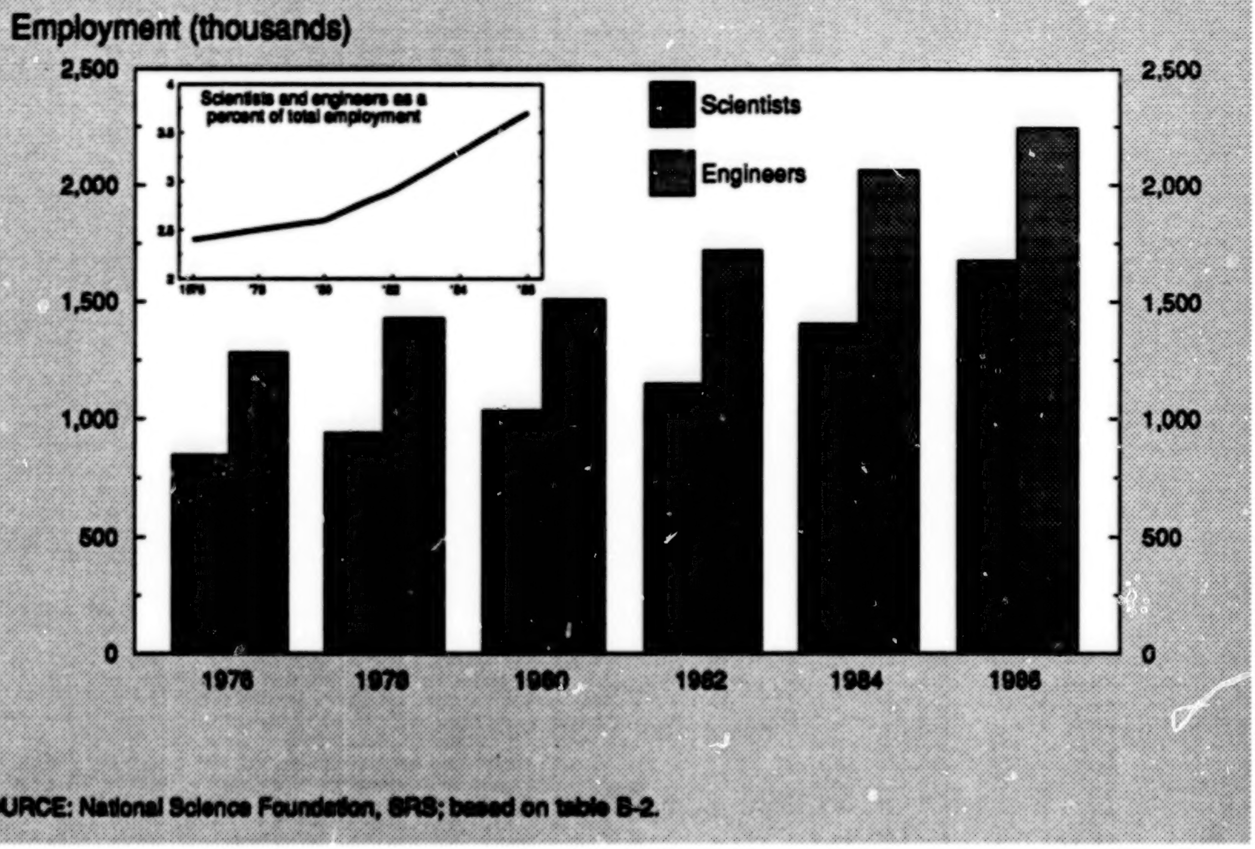
Chart 2. Percent change in employment of scientists and engineers in S/E jobs, by field: 1976-86



1986 employment estimates	
Total scientists and engineers	3,919,900
Total scientists	1,676,400
Physical scientists	264,900
Mathematical scientists	103,900
Computer specialists	437,200
Environmental scientists	97,300
Life scientists	340,500
Psychologists	172,800
Social scientists	259,800
Total engineers	2,243,500
Aeronautical/astronautical	104,200
Chemical	131,500
Civil	319,300
Electrical/electronics	540,800
Mechanical	453,700
Other	694,200

SOURCE: National Science Foundation, SRS; table B-2.

Chart 3. Scientists and engineers employed in S/E jobs: 1976-86



SOURCE: National Science Foundation, SRS; based on table B-2.

of scientists were concentrated in two fields; the same was true for engineers. Among scientists, 46 percent were employed as either computer specialists or life scientists; 44 percent of engineers were either electrical/electronics or mechanical engineers.[6]

Scientists' employment growth rose faster than did engineers' throughout most of the 1976-86 decade; this disparity was particularly pronounced in the most recent 2-year period. Between 1984 and 1986, employment in science occupations increased at an annual average rate of 9.3 percent—more than twice the 4.3-percent rate for engineers (chart 4). Above average growth in two fields—the computer specialties, where employment rose 13 percent between 1984 and 1986, and the social sciences, which increased 12 percent—accounted for the more rapid growth in employment of scientists. In contrast, the slowest growth rates among scientists were in the environmental and physical sciences (4 percent and 6 percent, respectively).

Among engineering subfields, electrical/electronics and aeronautical/astronautical engineers registered the fastest annual employment increases between 1984 and 1986—7 percent each. As a result of the restructuring of the U.S. chemicals industry,[7] employment of chemical engineers had the lowest rate of increase: less than 2 percent per year.

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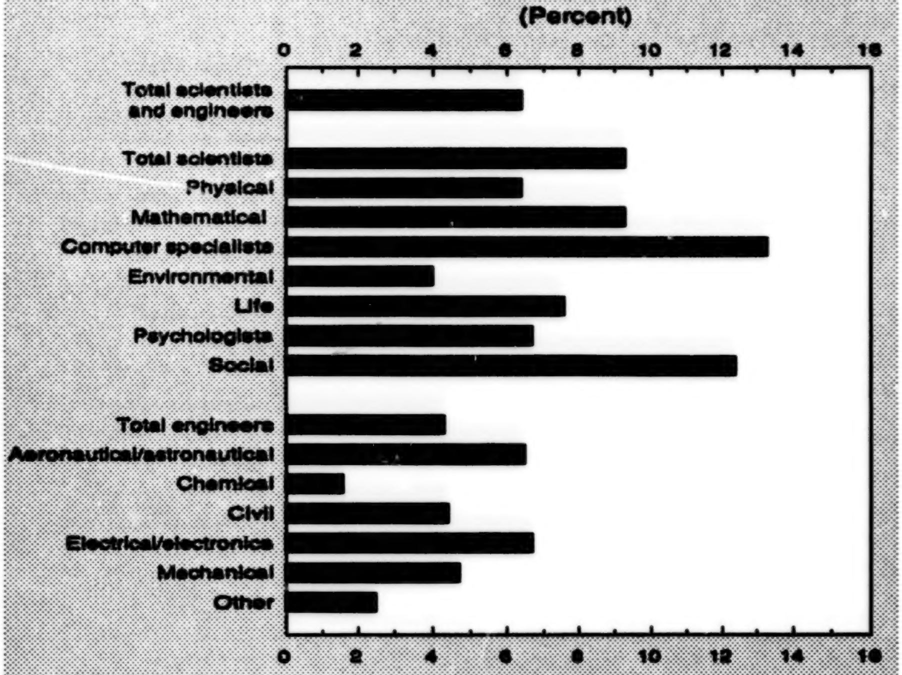
[6] Persons employed in specific S/E fields frequently have degrees in other fields, e.g. many computer specialists have degrees in engineering.

[7] American Chemical Society, "Unemployment Slightly Higher for Chemists in the Past Year," *Chemical and Engineering News*, June 30, 1986, p. 23.

Chart 4. Annual rates of employment growth for scientists and engineers in S/E jobs, by field: 1984-86



SOURCE: National Science Foundation, SRS; table B-2.

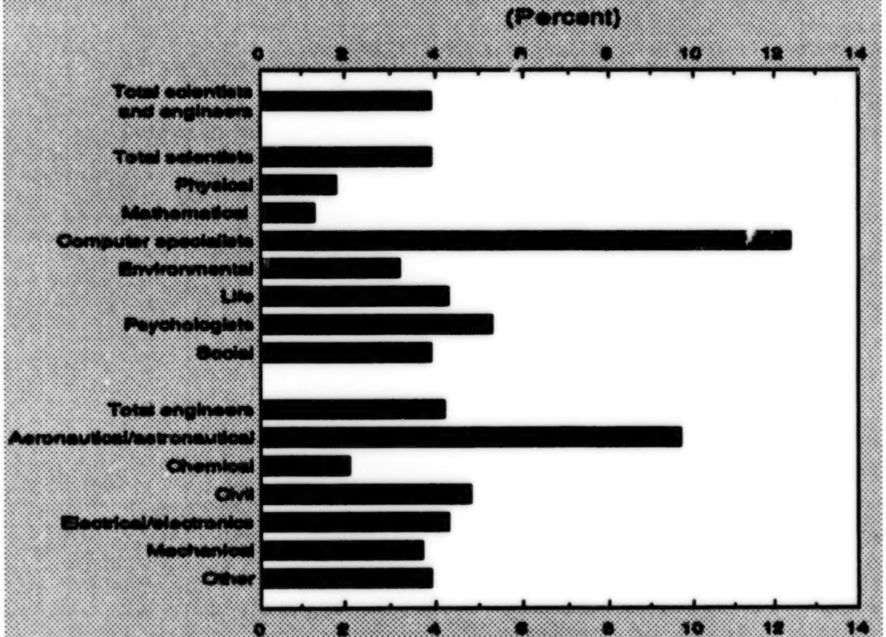
doctoral employment

Employment of those holding S/E doctorates reached 419,000[8] in 1987, an increase of 47 percent (3.9 percent per year) over 1977. Since 1981, however, employment growth of S /E doctorate-holders has slowed. The annual rate of increase for the 1981-87 period was less than 4.0 percent per year, compared to 4.8 percent annually between 1977 and 1981.

Scientists at the doctoral level outnumbered engineers by about five to one in 1987 (351,000 versus 68,000), a ratio virtually unchanged since 1977. The higher proportion of science doctorate-holders reflects (1) their relative concentration in academia and (2) the higher level of education needed by scientists (compared to engineers) for professional status. Within both science and engineering, doctoral employment growth rates varied considerably by field over the 1977-87 decade (chart 5). Among the sciences, where overall growth was approximately 4 percent per year, the lowest rate was in the mathematical sciences (1.4 percent); computer specialties was the fastest growing field (over 12 percent annual growth). Growth among the engineering subfields varied within a narrower range. Overall employment of doctoral engineers also increased at an annual rate of about 4 percent; by subfield, growth ranged from 2.1 percent per year for chemical engineers to almost 10 percent per year for aeronautical/astronautical engineers.

The differing growth rates altered the field distributions of the S/E doctoral workforce over the 1977-87 decade. Among scientists, the proportions employed as computer specialists, psychologists, life scien-

Chart 5. Annual rates of employment growth for doctoral scientists and engineers, by field: 1977-87



SOURCE: National Science Foundation, SRS; table B-4.

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[8] Includes 35,900 S/E doctorate-holders employed in non-S/E jobs. Detailed data comparable to that for all scientists and engineers employed in S/E jobs are not available.

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tists, and social scientists increased while the percentages employed as physical and mathematical scientists declined. In contrast, there were relatively modest shifts among engineering subfields (chart 6).

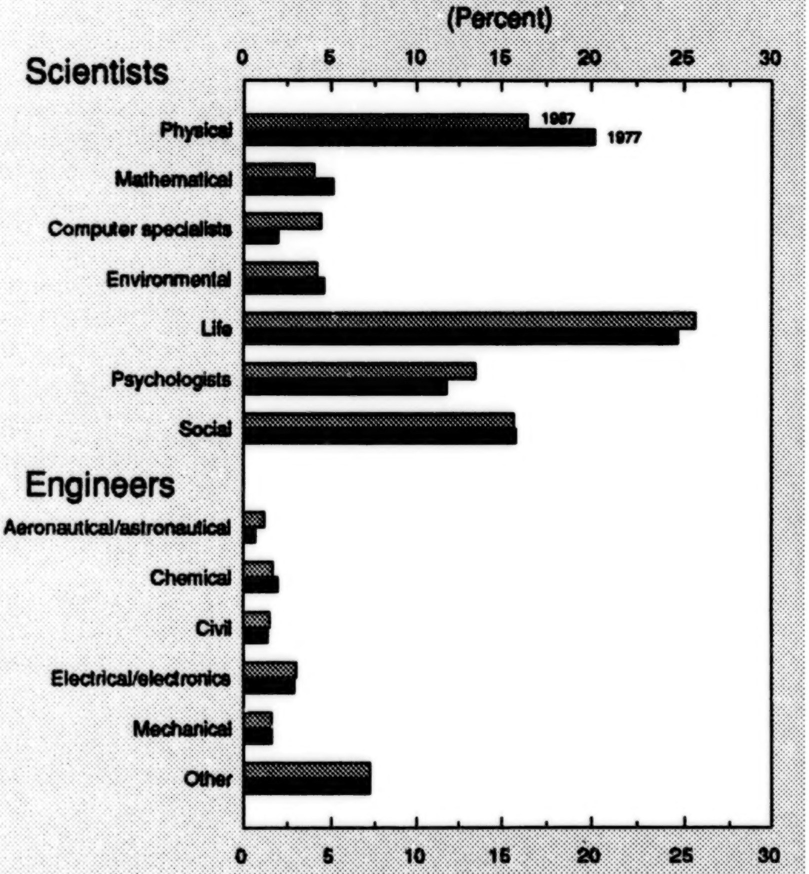
trends in s/t activities

Patterns in the primary work activities of scientists and engineers are direct indicators of the character of U.S. S/T work. By observing trends in the number and percentage distribution of those engaged in R&D, teaching, and other activities, the responsibilities of the Nation's S/E workforce can be discerned.

Over the 1976-86 period, the number of scientists primarily engaged in R&D expanded by about 100 percent, while the number of engineers predominately employed in R&D increased by almost 90 percent (chart 7). Scientists were more likely than engineers to report research as their primary activity in 1986 (17 percent versus 4 percent), while engineers were more likely to be involved in development (30 percent versus 10 percent) (chart 8). An additional 9 percent of scientists and 10 percent of engineers were working in R&D management in 1986. Despite these increases in number, R&D (including R&D management) remained the principal activity of 36 percent of the Nation's scientists and 45 percent of its engineers in 1986; these were approximately the same rates as in 1976.

Between 1977 and 1987, the number of doctoral scientists working primarily in R&D increased by about 64 percent each, while the number of doctoral engineers similarly employed rose 73 percent. Approximately 33 percent of Ph.D. scientists and 29 percent of Ph.D. engineers reported research as their primary work activity in 1987, with another 3 percent and 14 percent, respectively, working in development. About 6 percent of doctoral

Chart 6. Percent distribution of employed doctoral scientists and engineers, by field: 1977 and 1987



SOURCE: National Science Foundation, SRS; table B-4.

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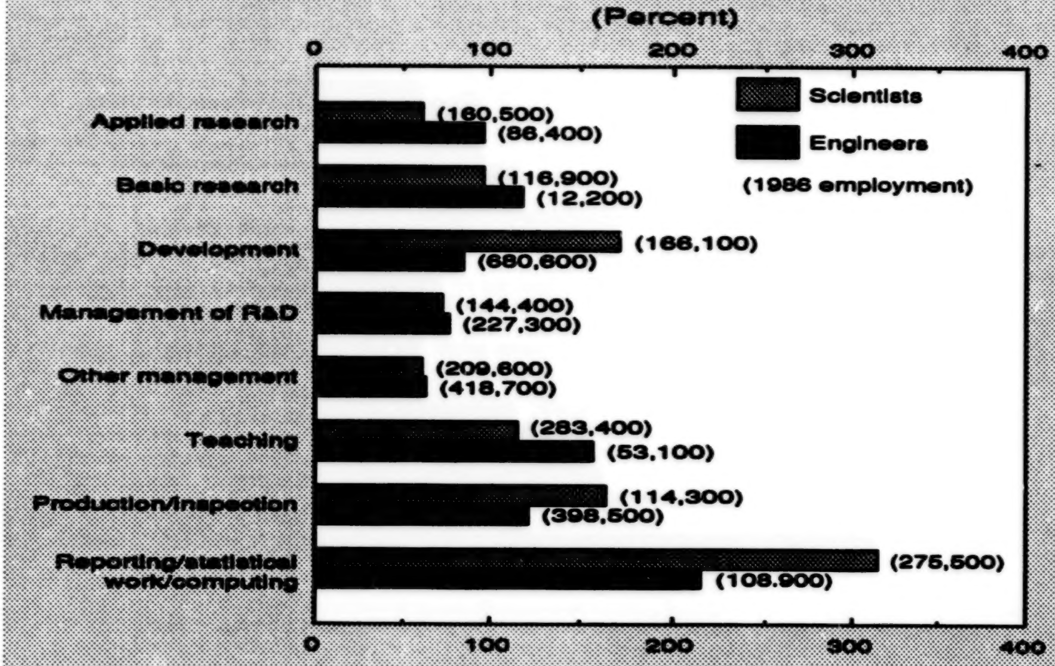
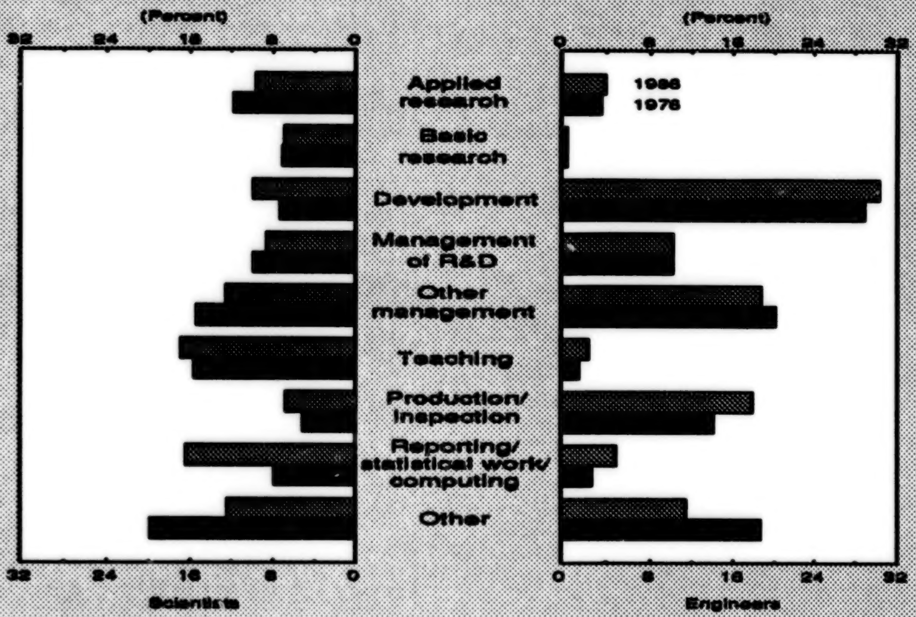
Chart 7. Percent change in employment of scientists and engineers in S/E jobs, by primary work activity: 1976-86



SOURCE: National Science Foundation, SRS; table B-5.

Chart 8. Percent Distribution of scientists and engineers employed in S/E jobs by primary work activity: 1976 and 1986



SOURCE: National Science Foundation, SRS; table B-5.

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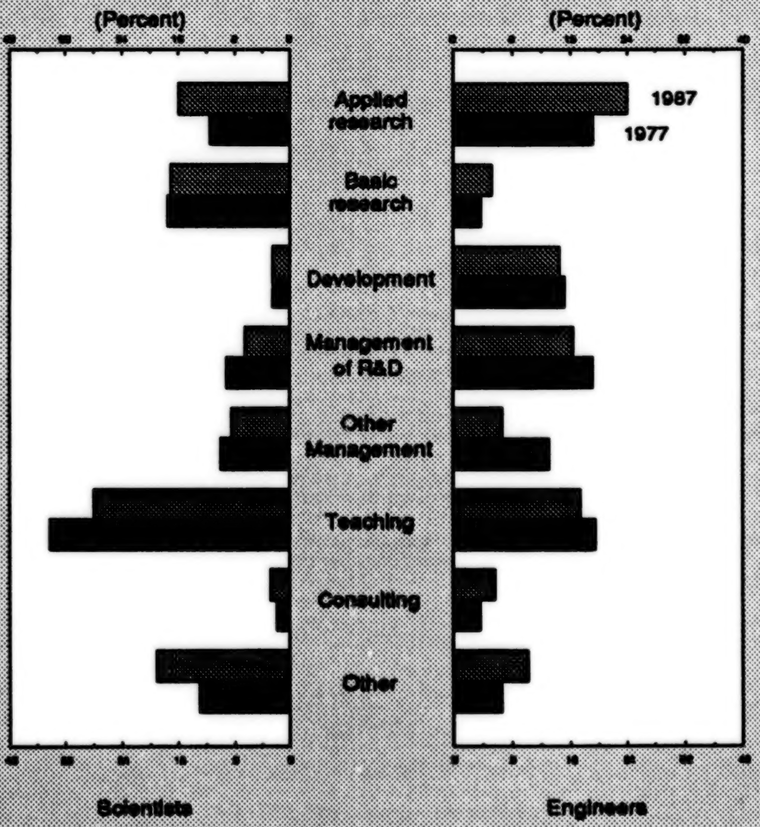
scientists and 16 percent of doctoral engineers cited R&D management as their primary work activity in 1987. This was down from 9 percent and 19 percent, respectively, in 1977 (chart 9).

Employment in teaching activities increased at an average rate of 8 percent per year for scientists and 10 percent for engineers between 1976 and 1986. Of the 336,600 scientists and engineers who reported teaching as their primary work activity in 1986, however, more than four-fifths were employed in science fields. Overall, approximately 17 percent of employed scientists, but only 2 percent of engineers, reported teaching as their principal activity. (In educational institutions, about twice as many scientists were primarily engaged in teaching (54 percent) as research (26 percent), approximately the same ratio as for engineers, 46 percent and 22 percent, respectively.) At the doctoral level, 28 percent of scientists and 17 percent of engineers reported teaching as their primary work activity in 1987. These proportions were down from 34 percent and 20 percent, respectively, in 1977, reflecting the shift in Ph.D. concentration from academia to industry.

While teaching activities were dominated by scientists during the 1976-86 period, production and related activities, including quality control, remained a major work area for engineers. Almost 18 percent (398,500) of employed engineers in 1986 reported that they were working in production and related activities, compared to less than 7 percent (114,300) of scientists. For 1976, the comparable rates were 5 percent (43,400) for scientists and 14 percent (179,800) for engineers.

Reporting, statistical work, and computing activities saw the largest increases in participation for both scientists and engineers between 1976 and 1986. The number of scientists primarily engaged in these activities rose fourfold over the period, increasing from 66,600 to 275,500; the number of engineers more than tripled, rising from 34,600 to 108,900. The proportion of all scientists employed in these activities increased from 8 percent to 16 percent over the 1976-86 period, while the percentage of engineers rose from less than 3 percent to almost 5 percent.

Chart 9. Percent distribution of employed doctoral scientists and engineers by primary work activity: 1977 and 1987



SOURCE: National Science Foundation, SRS; table B-6.

sectoral trends in the s/e workforce

Business and industry is the primary employer of scientists and engineers. In 1986, this sector provided jobs for 48 percent of all scientists and 80 percent of all engineers (chart 10). Academia was the second largest source of S/E employment in that year, employing 29 percent of all scientists and 4 percent of all engineers. The third largest employer, the Federal Government, employed 12 percent of all scientists and 8 percent of all engineers in 1986. Since 1976, the S/E employment shares for business and industry and academia have increased by about 4.0 percent and 2.0 percent, respectively; the share employed by the Federal Government has declined by 1.5 percent.

Sectoral changes have been more pronounced at the doctoral level. Although educational institutions remained the primary employer of S/E doctorate-holders in 1987, this sector's employment share has declined steadily since the late-1970s. Concurrently, industry's share of doctoral scientists and engineers has increased. In 1977, 62 percent of Ph.D. scientists and 35 percent of Ph.D. engineers were employed in academia; by 1987, the

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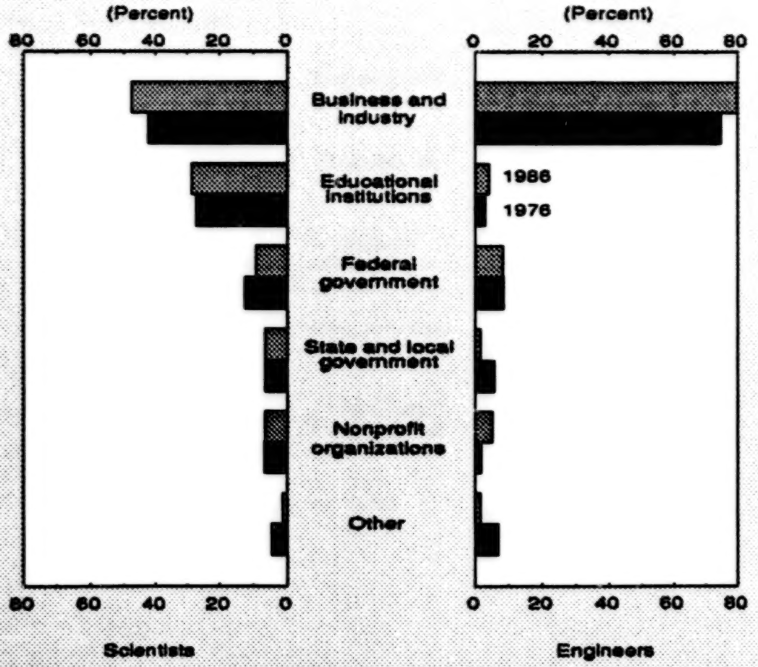
Chart 10. Percent distribution of scientists a engineers employed in S/E jobs, by sector of employment: 1976 and 1986



SOURCE: National Science Foundation, SRS; table B-7.

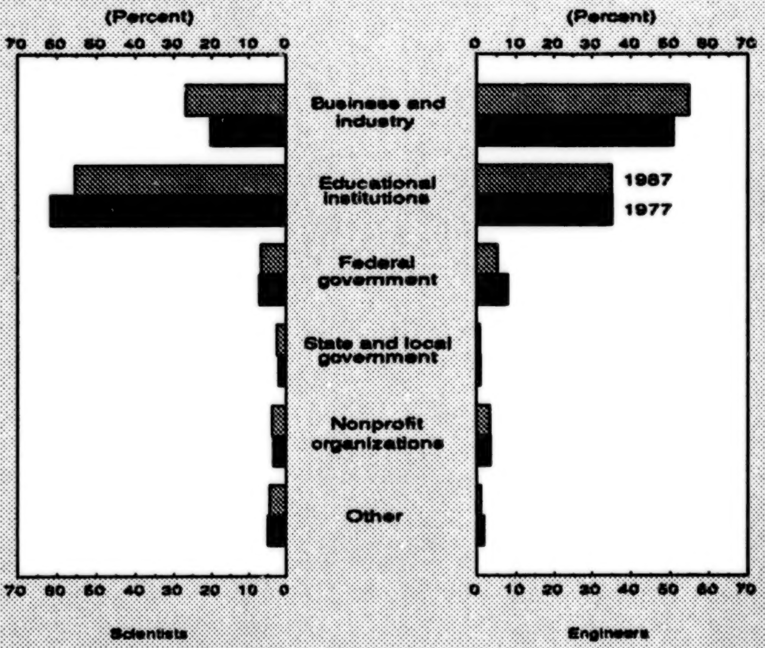
proportion of Ph.D. scientists had dropped to 57 percent, while the percentage of doctoral engineers had remained the same. Over the same period, the proportion of doctoral scientists employed in business and industry increased from 20 percent to 27 percent, while that of engineers rose from 51 percent to 55 percent (chart 11).

the industrial perspective

Business and industry overshadows all other major sectors in the employment of scientists and engineers. It therefore plays a dominant role in setting current and future demand for these workers. Over the 1976-86 decade, industry accounted for over 70 percent of the 1.8-million person S/E employment growth in the United States. Industry's employment of scientists increased at an average annual rate of 8.3 percent over this period; this was over one-half of the decade's total U.S. increase in scientists. Engineers in business and industry grew by 6.5 percent annually, and this sector accounted for almost 90 percent of the total U.S. employment growth in this field. In recent years, however, industrial S/E employment has slowed; two recessions in the early eighties, subsequent moderate growth in GNP, and the regrouping of U.S. industry to enhance its international competitive position have all contributed to reduced growth.[9]

S/E employment by field. Approximately 800,000 scientists and 1.8 million engineers were employed in the industrial sector in 1986 (chart 12). There was considerable variation in employment levels among S/E fields: this reflects the S/T importance of the different S/E specialties to industry. For example, almost 43 percent of industrial scientists were working in computer specialties in 1986, a clear in-

Chart 11. Percent distribution of employed doctoral scientists and engineers, by sector of employment: 1977 and 1987



SOURCE: National Science Foundation, SRS; table B-8.

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[9] National Science Foundation, *Science and Technology Resources in American Industry*, NSF 88-321 (Washington, D.C., 1988).

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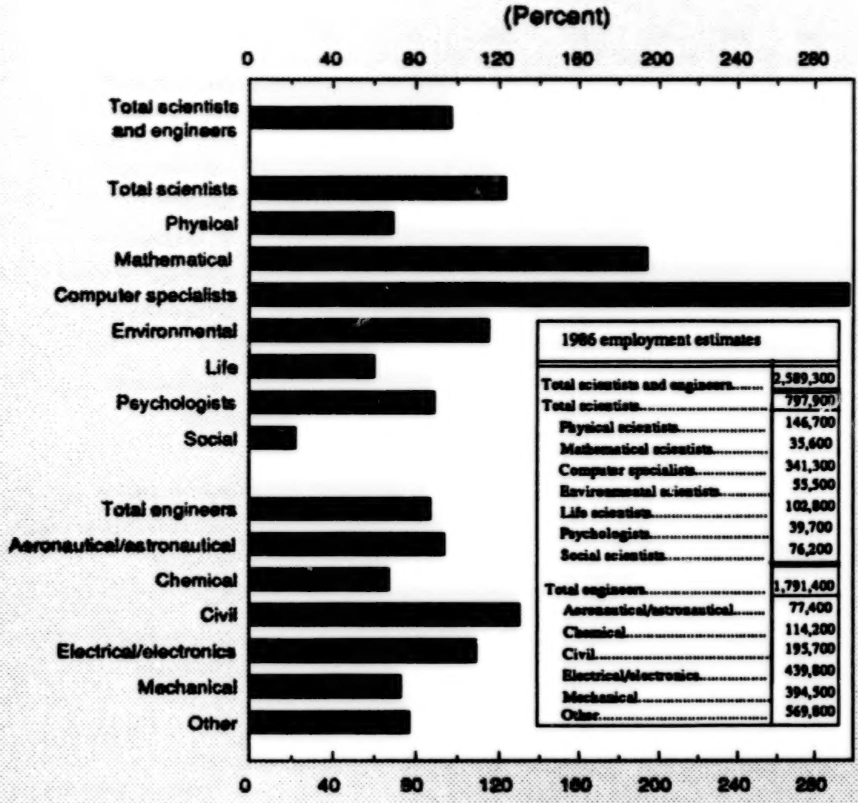
Chart 12. Percent change in employment of scientists and engineers in S/E jobs in business and industry, by field: 1976-86



1986 employment estimates	
Total scientists and engineers	2,589,300
Total scientists	797,900
Physical scientists	146,700
Mathematical scientists	35,600
Computer specialists	341,300
Environmental scientists	55,500
Life scientists	102,800
Psychologists	39,700
Social scientists	76,200
Total engineers	1,791,400
Aeronautical/astronautical	77,400
Chemical	114,200
Civil	195,700
Electrical/electronics	439,800
Mechanical	394,500
Other	569,800

SOURCE: National Science Foundation, SRS; table B-7.

dicator of the growing industrial emphasis on computer technology. Over the 1976-86 decade, computer specialists accounted for nearly three-fifths of the employment growth in science fields, increasing at an average annual rate of 15 percent.

Of the natural sciences, the physical and life sciences were the largest fields of employment in 1986, comprising about one-third of science employment in industry. The social sciences and psychology together accounted for another one-quarter of industrial employment in the sciences.

Growth in engineering employment within business and industry was relatively robust over the 1976-86 decade across engineering subfields. Expansion of high-technology industries, combined with increased job opportunities generated by high levels of defense expenditures and greater technological competition, have contributed significantly to this growth. Nevertheless, in the latter 2 years of the decade, employment growth has slowed in virtually all engineering subspecialties (chart 13).

Industry's employment of engineers between 1976 and 1986 was concentrated primarily in electrical/electronics and mechanical engineering, each of which employed about one-quarter of those engineers in the sector. During the decade, the fastest average annual growth—almost 9 percent—was experienced by the civil engineering subfield. The electrical/electronics subfield was not far behind, however, with an average rate of over 7 percent per year. Furthermore, while employment growth in all engineering subfields declined between 1984 and 1986, electrical/electronics engineering continued its vigorous growth, leading the other major subfields with an average annual increase of 6 percent.

Doctoral employment. Since the late-seventies, the sectoral distribution of doctoral scientists and engineers has shifted toward business and industry, increasing at average annual rates of 6.9 percent and 5.0 percent, respectively. By 1987, 27 percent of all Ph.D. scientists and 55 percent of all Ph.D. engineers worked in industry. Computer specialties, psychology, and the social sciences were the fastest growing science fields for doctorate-holders employed in industry; aeronautical/astronautical, civil, and electrical/electronics were the fastest growing engineering subfields.

Overall, industrial employment of S/E doctorate-holders has slowed since the beginning of the eighties. Between 1981 and 1987, the employment of doctoral scientists in industry increased at an average annual rate of less than 6.0 percent annually; doctoral engineering employment rose 2.6 percent per year. These declining growth rates reflect several factors, including a greater demand by academia for S/E doctorate-holders; a shortage of doctoral personnel in such high-demand S/E fields as computer science and certain engineering specialties; and the relatively strong growth in development activities, which, as compared to basic and applied research, are generally carried out by less highly trained personnel.[10] A few S/E fields did not experience a declining growth rate in the latter half of the 1977-87 decade. These were the life sciences and aeronautical/astronautical, electrical/electronics, and nuclear engineering. Growth in the engineering subfields likely has been sus-

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[10] Ibid.

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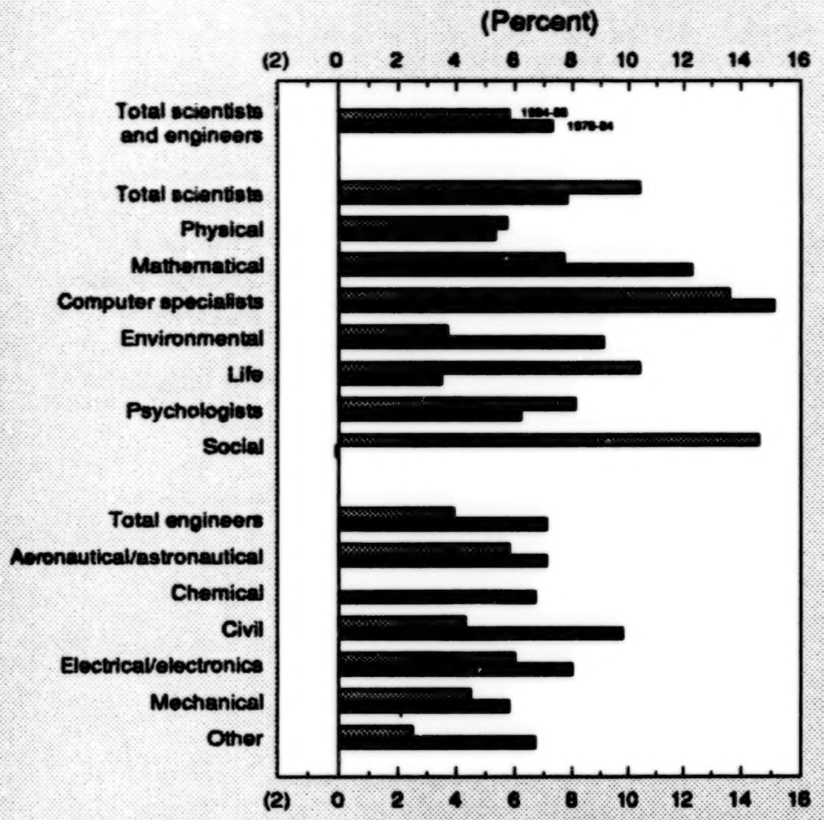
Chart 13. Annual rates of growth for scientists and engineers employed in S/E jobs in business and industry: 1976-84 and 1984-86



SOURCE: National Science Foundation, SRS; table B-7.

tained by defense-related requirements.[11]

Industry s/e job trends.[12] Between 1980 and 1988, the number of those employed in S/E jobs in private industry increased at more than twice the rate for all workers. Concurrently, there have been major changes in the occupational and industrial mix of S/E employment. Notably, the services-producing industries benefitted from substantial economic growth as reflected in a 29-percent increase in total jobs; this included a 57-percent increase in S/E employment (chart 14). In the goods-producing sector, growth in S/E occupations has stemmed from an increased share of total manufacturing jobs.

Note that the recent growth of service industries and their S/E employment does not reflect a transference to them (via contracting out) of activities formerly performed in-house by goods-producing industries. The data show that such transference is not a major factor since both the numbers and share of total employment in technical occupations within the goods-producing sector are increasing. Further, according to a recent study by the Bureau of Labor Statistics, the transfer of work formerly done in-house by manufacturers accounted for—at best—only a small fraction of the growth in the services-producing sector. The primary cause of this sector's growth has been attributed to increases in the supply of new services.[13] The continued development of new services should keep demand for the outputs of services-producers on the rise, even as scientific and technical employment in the goods-producing industries which they service continues their upward trend.

Services-producing industries. The services-producing industries are divided into four major categories: (1) communications, utilities, and transportation; (2) trade; (3) financial services; and (4) business and related services. Together, these industries provided jobs for approximately 446,000 engineers and 359,000 scientists in 1988, up from 306,000 and 207,000, respectively, in 1980.

Over the 1980-88 period, the concentration of private sector S/E jobs shifted gradually from goods-producing industries to services-producing industries, with the proportion in the latter sector increasing from 38 percent in 1980 to an estimated 43 percent in 1988.[14] The increase during this period can be attributed both to a faster rate of employment growth for S/E personnel in services-producing industries, and to the sector's general economic and employment growth as reflected in its total employment expansion. Overall, employment in services-producing industries grew at an average annual rate of 3.2 percent between 1980 and 1988; the number of S/E jobs increased on average by 5.8 percent. The proportion of the services-producing

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[11] Ibid.

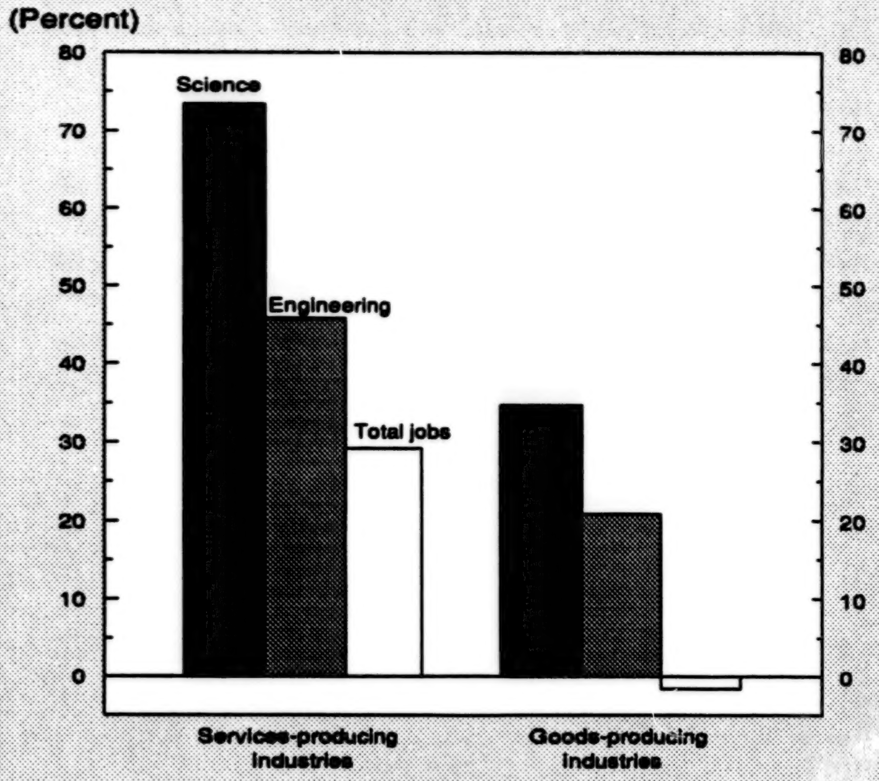
[12] Analysis in this section is based on data from the Occupational Employment Statistics (OES) survey, conducted by the Bureau of Labor Statistics. This is a large establishment-based survey that collects information on employment in S/E jobs. It differs from the Scientific and Technical Personnel Data System (STPDS) in that individuals filling these jobs need not be formerly trained in the sciences or engineering; the jobs require a level of skill equivalent to 4 years of training in a related S/E field.

A major difference critical to the analysis of industrial employment is the treatment of managers. The OES data reported here would not necessarily classify S/E personnel engaged in management as part of the S/E workforce. In the OES survey, management is a unique occupation; in the STPDS, management is a 32 permissible S/E job function. Annual data reported in this section are based on estimates generated by NSF. See appendix A for an explanation of the OES survey and S/E job estimating methodology.

[13] John Tschetter, "Producer Services Industries: Why Are They Growing So Rapidly?," *Monthly Labor Review*, December 1987, pp. 31-39.

[14] National Science Foundation, "Services Led in Private Industry Growth in Science/Engineering Jobs but Manufacturing Rebounds and Tops 1 Million in 1987," *Science Resources Studies Highlights*, NSF 88-304 (Washington, D.C., March 31, 1988, p. 2.

Chart 14. Increase in science, engineering, and total jobs in private industry, by sector: 1980-88



SOURCE: National Science Foundation, SRS; table B-18.

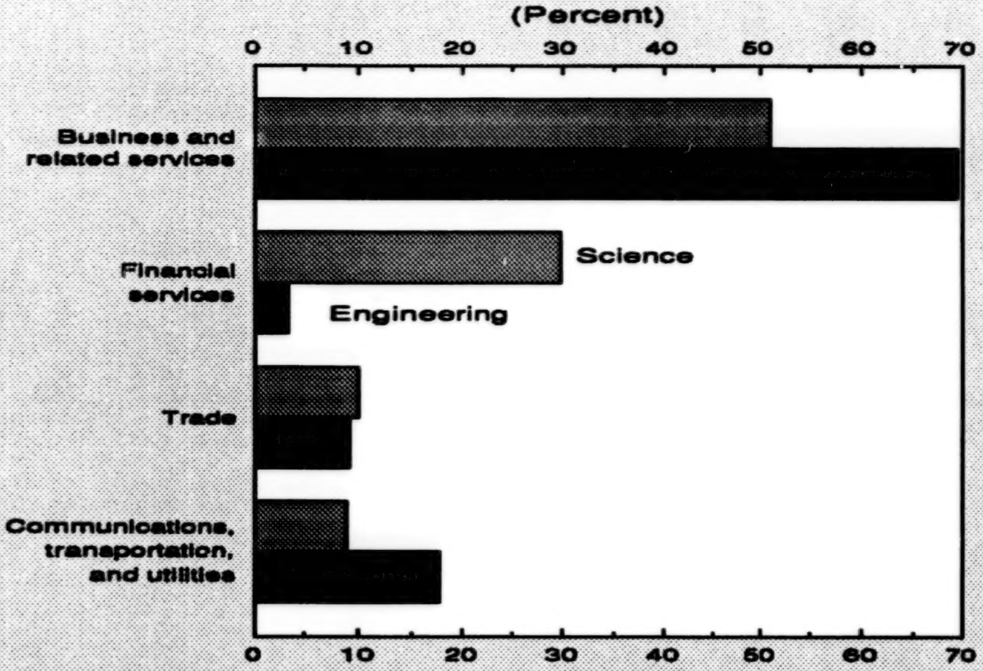
workforce in S/E positions increased during this time from 1.3 percent of total employment in 1980 to an estimated 1.6 percent in 1988.

Business and related services was the largest and second fastest growing division of the services-producing sector over the 1980-88 period. The major employers of S/E workers in this division were involved in computer and data processing services, engineering and architectural services, and independent R&D. In 1988, there were 310,000 engineering and 183,000 scientist positions in this division; these represented 68 percent and 51 percent, respectively, of the services-producing sector's engineering and science jobs (chart 15). During the 1980-88 period, the number of jobs for engineers increased at an average rate of 7.1 percent per year, slightly higher than the 5.3 percent annual rate for scientists (chart 16).

Several elements influenced S/E job growth in business and related services. The revolution in information technologies and the concurrent strong demand for information/data services created increasing employment opportunities for S/E workers in computer and data processing services. New methods of delivering information-related services led to the development of major new growth segments in this industry. For example, the extensive use of local area networks and electronic data interchange networks has developed mostly over the past 5 years.

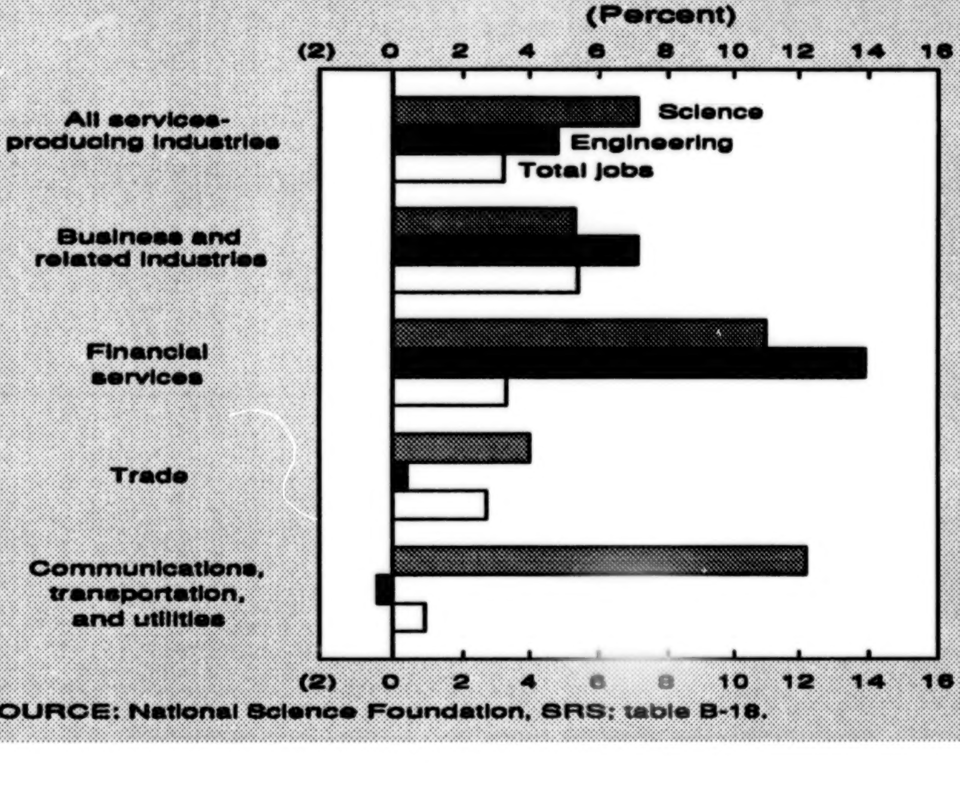
The most rapid S/E job growth in the services-producing sector occurred in the financial services division. Firms in this division are engaged in banking, credit, insurance, and real estate. Their increasing use of technological advances and computerized services resulted in greater requirements for computer specialists and mathematical and social scientists. Between 1980 and 1988, jobs for these workers increased at an average annual rate of almost 11 percent, and accounted for approximately 90 percent of the division's 122,000 S/E jobs in 1988.

Chart 15. Percent distribution of science and engineering jobs in services-producing industries: 1988



SOURCE: National Science Foundation, SRS; table B-18.

Chart 16. Annual rates of growth for science, engineering, and total jobs in services-producing industries: 1980-88



SOURCE: National Science Foundation, SRS; table B-18.

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Goods-producing industries. The four divisions of the goods-producing industries are durable goods manufacturing, nondurable goods manufacturing, mining, and construction. Together, they provided jobs for 830,000 engineers and 225,000 scientists in 1988, compared to 686,000 and 167,000, respectively, in 1980.

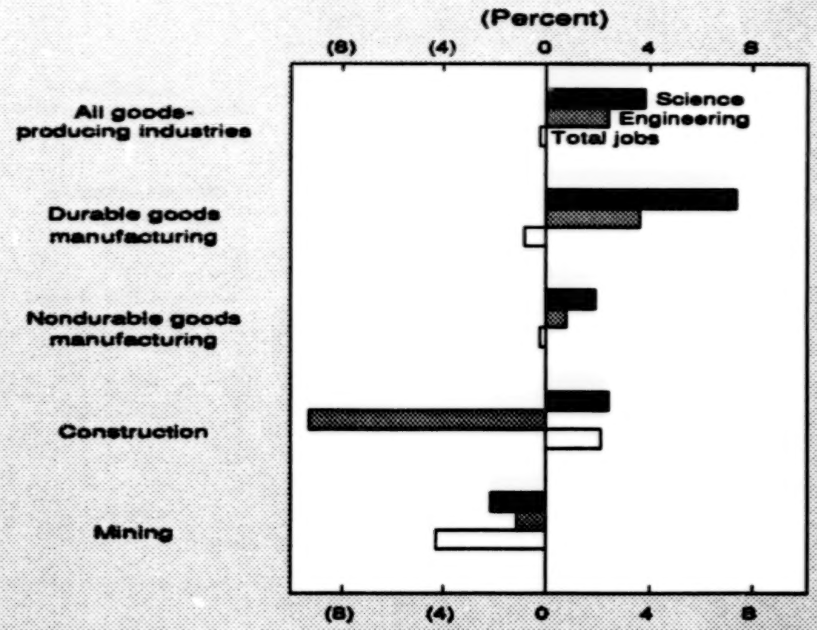
S/E jobs in goods-producing industries grew at an average rate of 2.7 percent per year between 1980 and 1988 (chart 17). Unlike the services-producing industries, total employment in this sector experienced no growth over this period: a small increase in total employment growth in construction was offset by employment declines in the other three divisions. However, S/E job growth in the manufacturing divisions was maintained for several reasons, including increases in defense spending, technological competition, pressure to increase productivity, high-technology capital investment, and R&D expenditures—all of which circumstances generated S/E employment.

Durable goods manufacturing is the sector's largest provider of S/E jobs (chart 18). In 1988, over 80 percent of the goods-producing sector's engineering jobs and 51 percent of its science jobs were located in this division. Major durable goods S/E employers within this division in 1988 were aerospace (i.e., manufacturers of aircraft and parts, space vehicles, and guided missiles), with 24 percent of the S/E jobs; communications equipment, 15 percent; office and computing equipment, 12 percent; and electronic components, 12 percent.

the academic perspective

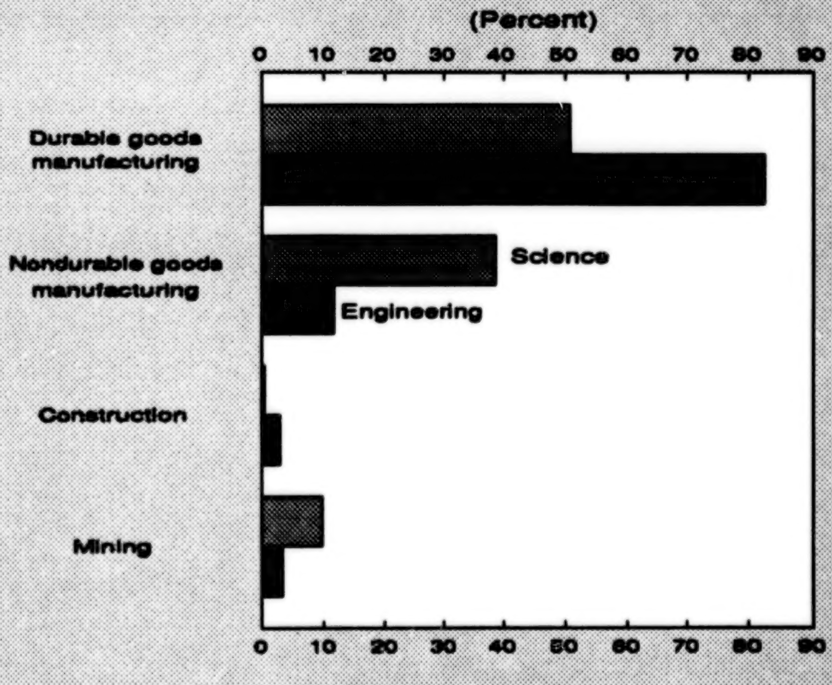
In 1986, educational institutions (primarily universities and colleges) employed about 29 percent of all scientists and 4 percent of all engineers in the United States. Over the 1976-86 decade, employment of scientists within academia increased at an average annual rate of almost 8 percent, while engineering employment rose at an average rate

Chart 17. Annual rates of growth for science, engineering, and total jobs in goods-producing industries: 1980-88



SOURCE: National Science Foundation, SRS; table B-18.

Chart 18. Percent distribution of science and engineering jobs in goods-producing industries: 1988



SOURCE: National Science Foundation, SRS; table B-18.

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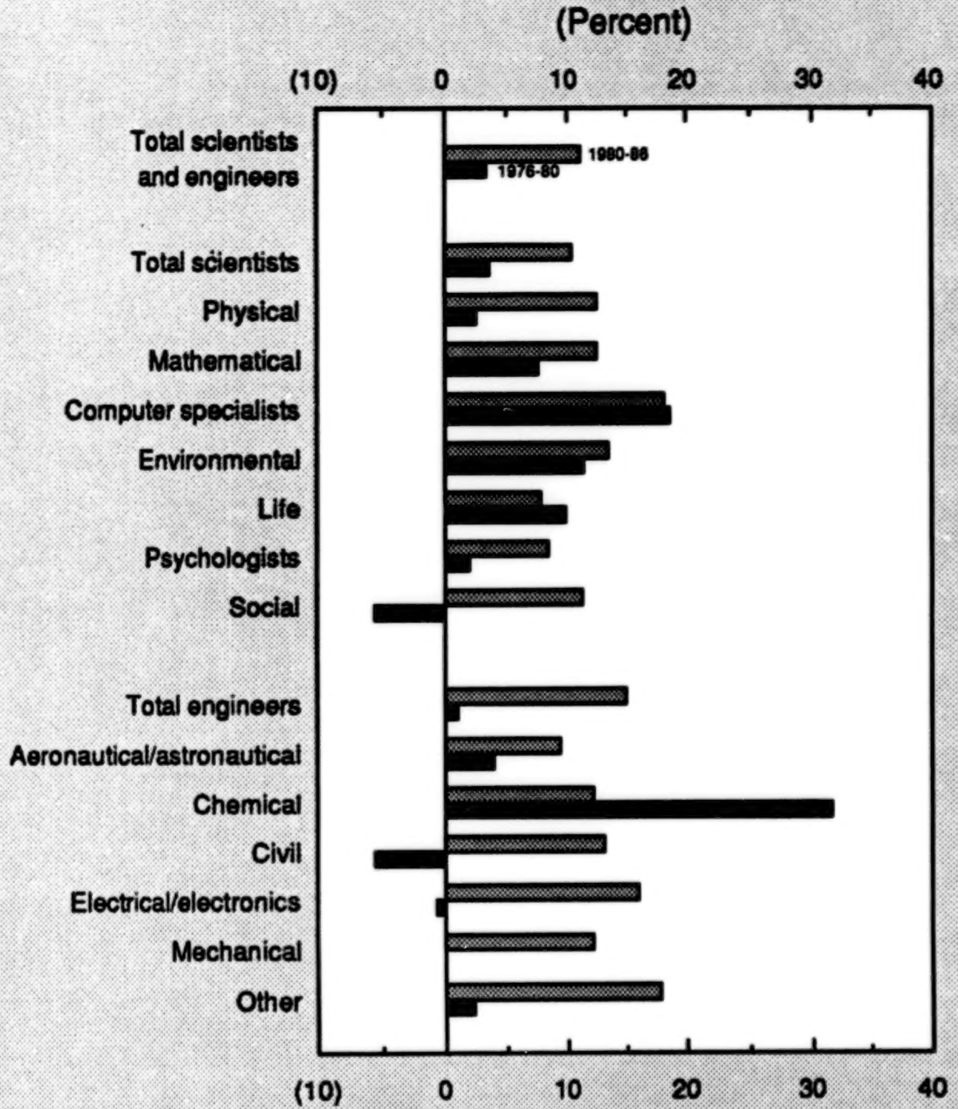
of over 9 percent per year. Almost all of this growth occurred after 1980: between 1980 and 1986, science employment in this sector increased at an average annual rate of over 10 percent, while engineering employment rose by 15 percent per year. Comparable growth rates for the 1976-80 period were 3.6 percent for scientists and 1.0 percent for engineers (chart 19).

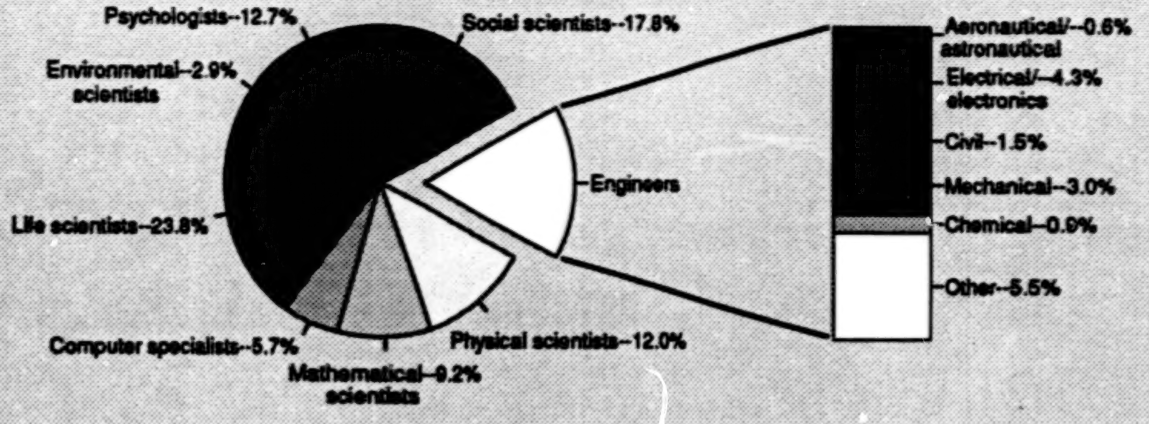
S/E employment by field. Of the 573,000 scientists and engineers working in educational institutions in 1986, almost 84 percent were employed in scientific fields. Of this percentage, one-half were either life scientists or social scientists. Electrical/electronics and mechanical engineering were the major subfields of engineering employment in academia, accounting for 27 percent and 18 percent, respectively, of all engineers in this sector in 1986 (chart 20). In comparison, the smallest fields of employment in academia for scientists and en-

Chart 19. Annual rates of growth for scientists and engineers employed in S/E jobs in educational institutions: 1976-80 and 1980-86



SOURCE: National Science Foundation, SRS; table B-7.

Chart 20. Distribution of scientists and engineers employed in S/E jobs in educational institutions: 1986



SOURCE: National Science Foundation, SRS; table B-7.

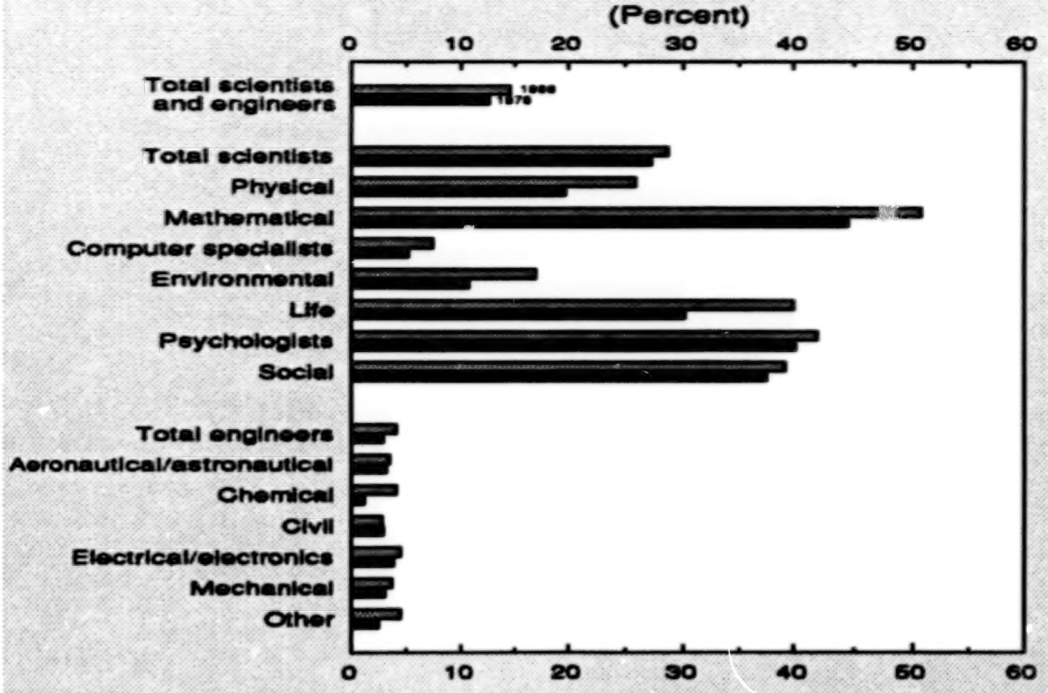
gineers were, respectively, environmental science (3.4 percent) and aeronautical/astronautical engineering (less than 4 percent).

As in industry, the importance of educational institutions in providing S/E employment opportunities varies significantly by field (chart 21). More than one-half of the Nation's mathematical scientists were employed in this sector in 1986. Academia also employed the majority of all psychological scientists (42 percent), life scientists (40 percent), and social scientists (38 percent) in the United States. The S/E fields least represented in this sector were computer specialties (7 percent) and engineering (4 percent).

Doctoral employment. Over the 1977-87 decade, doctoral S/E employment in educational institutions increased at an average rate of 2.9 percent per year; this was about one-half the 6.2-percent rate for industry. As a result of academia's slower growth, the proportion of the Nation's Ph.D. scientists employed in this sector declined from 62 percent to 55 percent, while the percentage of doctoral engineers remained constant at 35 percent. The relative importance of academia as a source of employment for S/E doctorate-holders varied considerably by occupational group; roughly three-fifths of all Ph.D. scientists were employed in this sector, compared to one-third of all doctoral engineers. Among S/E fields, educational institutions employed 62 percent of the Nation's Ph.D. life scientists, 45 percent of its doctoral psychological scientists, and 70 percent of social sciences doctorate-holders.

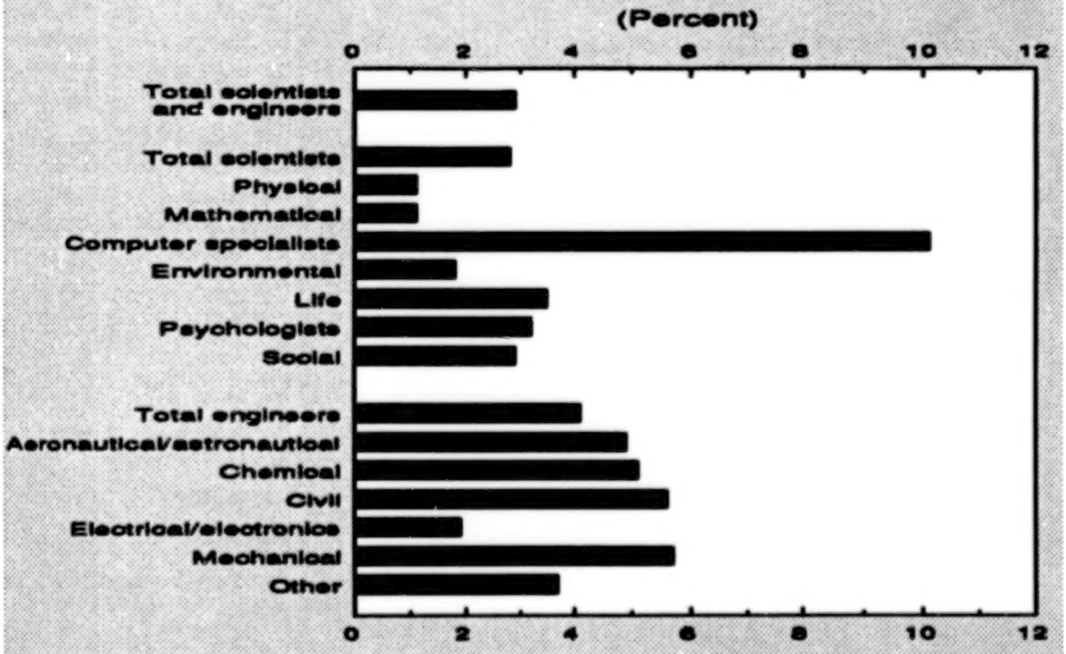
Growth in academic doctoral employment also varied by S/E field over the 1977-87 decade (chart 22). Computer specialties was the fastest growing field among Ph.D. scientists and engineers during this period, increasing at an average annual rate of 10 percent. Other major fields showing above average increases were the life sciences (3.5 percent), social sciences (almost 3 percent), and engineering (over 4 percent). Slower than average growth was recorded by physical and mathematical scientists, which each increased by only 1.1 percent per year. These differing growth rates changed the field distribution of doctoral scientists and engineers

Chart 21. Share of scientists and engineers employed in S/E jobs in educational institutions, by field: 1976 and 1986



SOURCE: National Science Foundation, SRS; table B-7.

Chart 22. Annual rates of growth for doctoral scientists and engineers employed in educational institutions: 1977-87

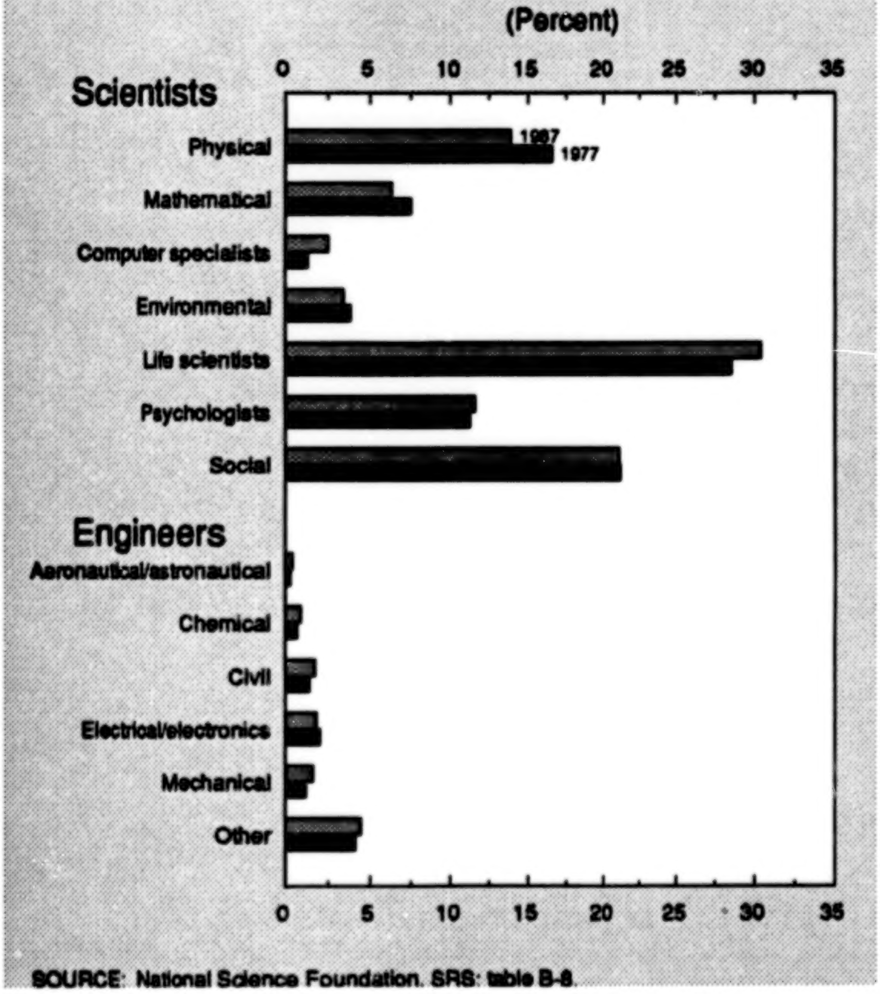


SOURCE: National Science Foundation, SRS; table B-8.

over the [illegible]. For example, the proportion of physical scientists declined from about 17 percent to 14 percent, while the proportion of engineers rose from 10 percent to 11 percent (chart 23).

Since the mid-1980s, doctoral S/E employment growth in academia has slowed. For example, employment of Ph.D. scientists increased at an average annual rate of 1.3 percent between 1985 and 1987, down substantially from an annual growth of 4 percent for the previous 2-year period. Opposite patterns were experienced by doctoral engineers, whose employment increased by slightly more than 3 percent annually over the 1983-85 period and then rose to more than 4.5 percent per year over the next 2-year period. However, the slower annual growth for doctoral engineers during the 1983-85 period was due primarily to general field switching by experienced Ph.D. engineers, rather than to a slowdown in the number of Ph.D.'s in engineering.[15]

Chart 23. Percent distribution of doctoral scientists and engineers employed in educational institutions: 1977 and 1987



SOURCE: National Science Foundation, SRS: table B-8.

the federal government perspective

In 1986, approximately 8 percent of both the Nation's scientists and engineers were employed by the Federal Government, making this sector the third largest employer of scientists and second largest employer of engineers. The life sciences and computer specialties were the largest science occupations within the Federal Government in 1986, accounting for 26 percent and 21 percent, respectively, of federally employed scientists. Over 54 percent of the Federal S/E labor force were employed in engineering occupations; of these, electrical/electronics and civil engineers accounted for the largest portions—29 percent and 17 percent, respectively.

Over the 1976-86 decade, Federal employment of scientists increased at a significantly slower average annual rate than that for engineers: 3.9 percent versus 5.5 percent. Among science fields, the highest annual growth was recorded by computer specialists, whose employment increased at a rate of almost 14 percent per year over the decade. Within engineering, electrical/electronics and mechanical engineers reported above average growth rates of 6.7 percent and 6.5 percent per year, respectively.

During the 1976-84 period, S/E employment growth in this sector lagged behind industry and academia. This reflected both the Federal Government's inability to compete in attracting S/E personnel and Administration efforts to constrain the size of the Federal workforce.[16] Between 1984 and 1986, however, Federal S/E employment growth outpaced that in the other two sectors, growing at an annual rate of 7.2 percent, compared to 5.8 percent in industry and 7.0 percent in educational institutions. This growth was attributed primarily to an increase in defense R&D spending and a relaxation of the hiring restraints imposed on Federal agencies in the early eighties.

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[15] National Science Foundation, "Employment of Ph.D. Scientists and Engineers Continues to Increase," *Science Resources Studies Highlights*, NSF 87-301 (Washington, D.C., 1987), p. 2.

[16] National Science Foundation, *Science and Technology Resources in American Industry*, op. cit.

women in science and engineering

Although women have made substantial gains in S/E employment over the last decade, they remained underrepresented in the S/E workforce in 1986. The 526,200 women scientists and engineers then employed in S/E fields represented about 13 percent of all scientists and engineers, up from 8 percent in 1976. As a proportion of the total workforce, however, only about 1 percent of all employed women were working in S/E jobs in 1986, compared to almost 6 percent of all employed men.[17] These proportions reflect the fact that, historically, women's participation in precollege science and mathematics courses and in undergraduate and graduate S/E education is below that of men.

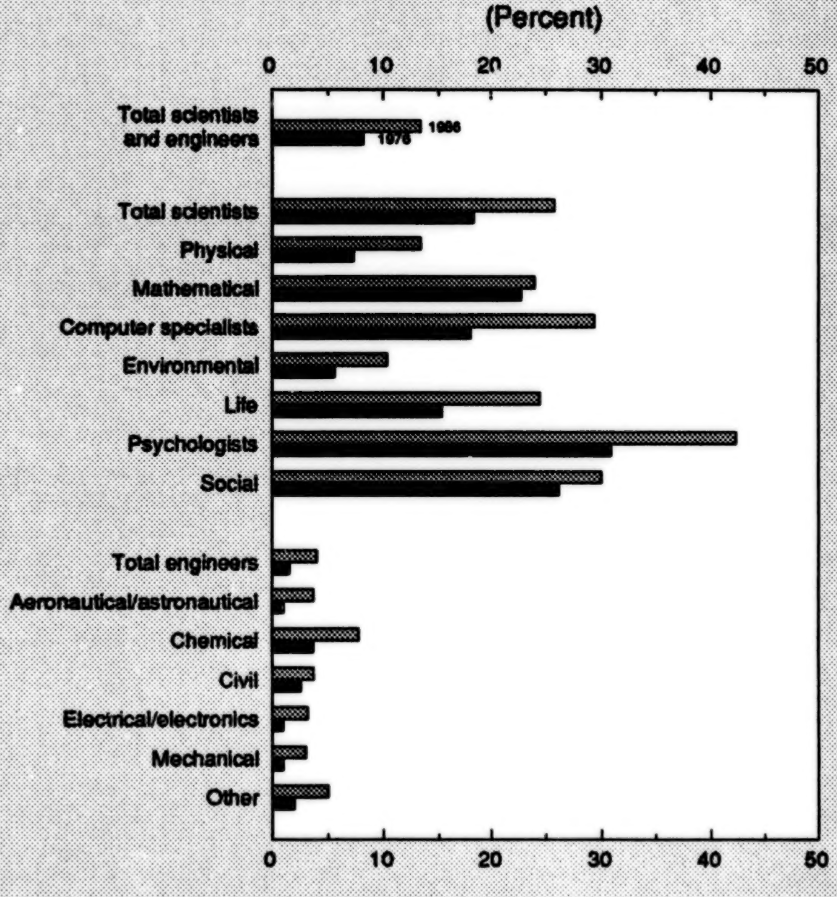
Regardless of field, women scientists and engineers are more likely than men to work in nonprofit organizations, academic institutions, and State and local governments. They are less likely than men to be employed in industry or the Federal Government. Because of the relatively recent influx of women into science and engineering, they are generally younger than their male colleagues and have fewer years of professional experience. In 1986, about three-fifths of women, compared to one-quarter of men, reported fewer than 10 years of professional experience.[18] Furthermore, only 15 percent of women, but 46 percent of men scientists and engineers, had more than 20 years of work experience.

Years of professional experience may be a factor in differences in career patterns between men and women in science and engineering. For example, among doctoral scientists and engineers employed in 4-year universities and colleges, men are more likely than women to hold tenure or be in tenure-track positions. In 1985, almost 80 percent of Ph.D. men were either tenured or in tenure-track positions, compared to 60 percent of Ph.D. women. Regarding academic rank, women were much less likely than men to hold full professorships, but almost twice as likely to hold assistant professorships.[19]

Women account for a much larger share of the science workforce than of the engineering: in 1986, almost 26 percent of all scientists were women, compared to only 4 percent of all engineers (chart 24). In the sciences, women were most strongly represented in psychology, accounting for 42 percent of all psychological scientists in 1986; they were least represented in the physical and environmental sciences (13 percent each). Women engineers were more likely to be chemical engineers (almost 8 percent) and least likely to be either mechanical or electrical/electronics engineers (3 percent each).

Since 1976, the field distribution of employed women scientists and en-

Chart 24. Women as percentage of scientists and engineers employed in S/E jobs by field: 1976 and 1986



SOURCE: National Science Foundation, SRS; table B-2.

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[17] U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, Vol. 34, No. 2 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, February 1987), p. 8.

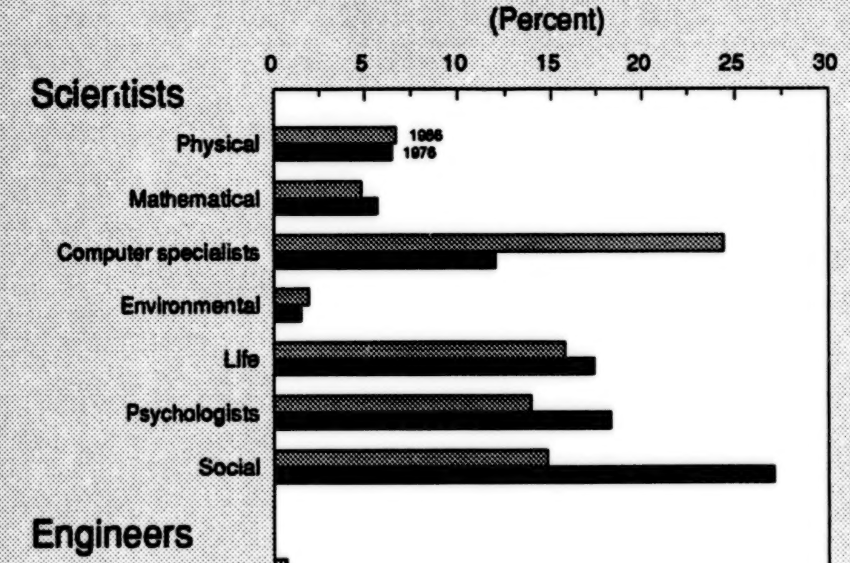
[18] National Science Foundation, *Women and Minorities in Science and Engineering*, NSF 88-301 (Washington, D.C., 1988), p. 6.

[19] Betty Vetter, "Women's Progress," *Mosaic*, NSF 86-88, Vol. 18, No. 1, Spring 1987, p. 7.

gineers has changed, reflecting differing S/E field growth patterns (chart 25). The most notable distribution shifts occurred in the computer specialties, engineering, and the social sciences. Between 1976 and 1986, employment of women computer specialists increased almost sixfold, jumping from 21,000 to 128,000. By 1986, 24 percent of women scientists and engineers were computer specialists, up from 12 percent in 1976. The number of women in engineering quadrupled over the decade, growing at an average annual rate of almost 16 percent; the proportion of women in science and engineering who were engineers rose from 11 percent to almost 18 percent. On the other hand, employment of women social scientists increased by only 65 percent between 1976 and 1986. This was much less than the 200-percent overall growth of women in all S/E fields. Because of this slower growth, the proportion of S/E women who were social scientists declined from 31 percent to 18 percent.

Employment of doctoral women, which more than doubled between 1977 and 1987, varied substantially among S/E fields. The fields with the greatest relative growth of women doctorates were computer specialties—which increased its employment of women Ph.D.'s from less than 250 in 1977 to almost 1,900 in 1987—and engineering—which increased from less than 300 to over 1,700 during the same period. Despite this rapid growth, only about 5 percent to 6 percent of women Ph.D.'s were either computer specialists or engineers in 1987 (chart 26). The life sciences, social sciences, and psychology together accounted for over 80 percent of the decade's increase in the employment of doctoral women. Overall, however, the field distribution of women with science doctorates did not change greatly over the 1977-87 period. Women were somewhat more likely to be psychological scientists or computer specialists and less likely to be mathematical or physical scientists in 1987 than in 1977.

Chart 25. Percent distribution of women scientists and engineers employed in S/E jobs: 1976 and 1986



racial minorities in science and engineering

Blacks, Asians, and native Americans differ in their representation among scientists and engineers, their representation in the general population, and their employment characteristics. Therefore, discussion of minorities in science and engineering must distinguish among the various racial groups.

Historically, blacks have been underrepresented in the S/E workforce, while Asians have been strongly attracted to S/E careers and native Americans have held a proportionate share. In 1986, blacks accounted for only 2.2 percent of those employed in S/E jobs (chart 27). In the general workforce, however, blacks represented 10 percent of total U.S. employment and almost 7 percent of those in professional and related occupations.[20] In contrast, Asians, although less than 2 percent of the U.S. labor force and

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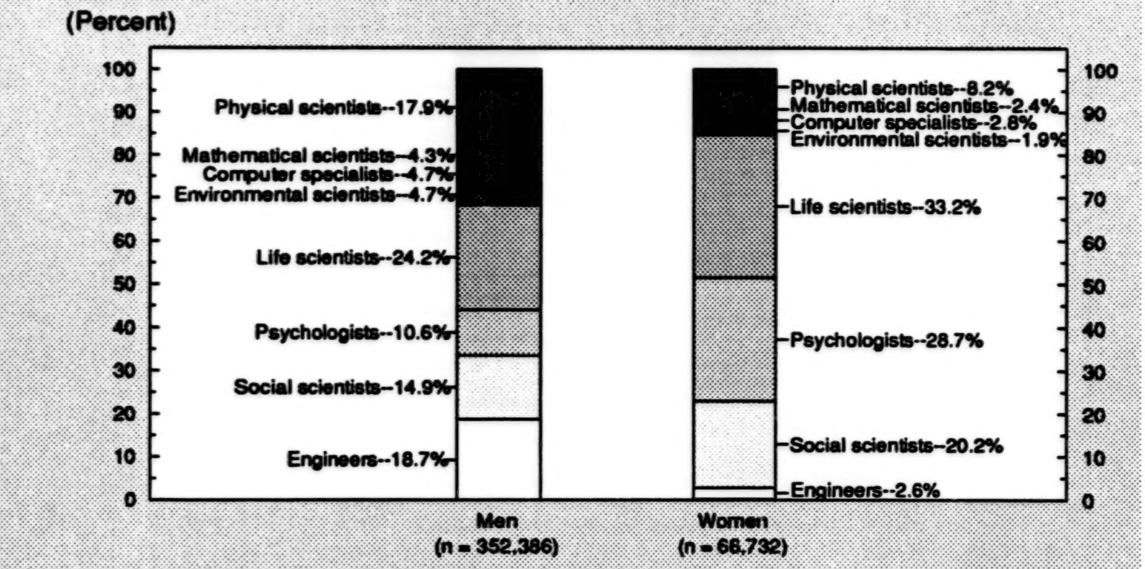
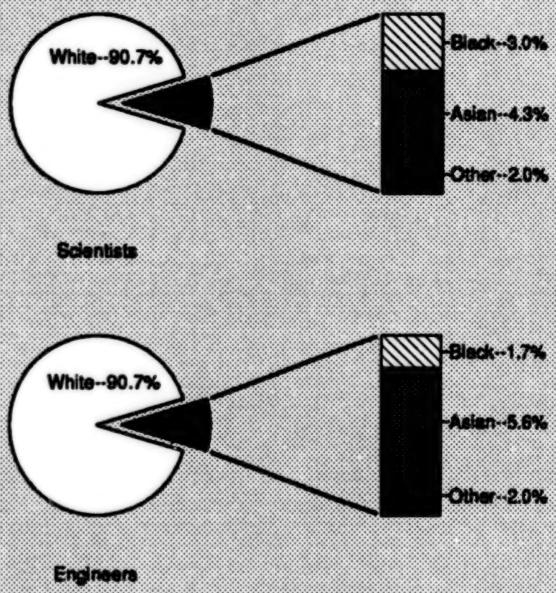
[20] U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, Vol. 34, No. 1 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, January 1987), p. 179.

Chart 26. Percent distribution of employed doctoral scientists and engineers, by field and gender: 1987



SOURCE: National Science Foundation, SRS; table B-4.

Chart 27. Distribution of scientists and engineers employed in S/E jobs, by race: 1986



SOURCE: National Science Foundation, SRS; table B-10.

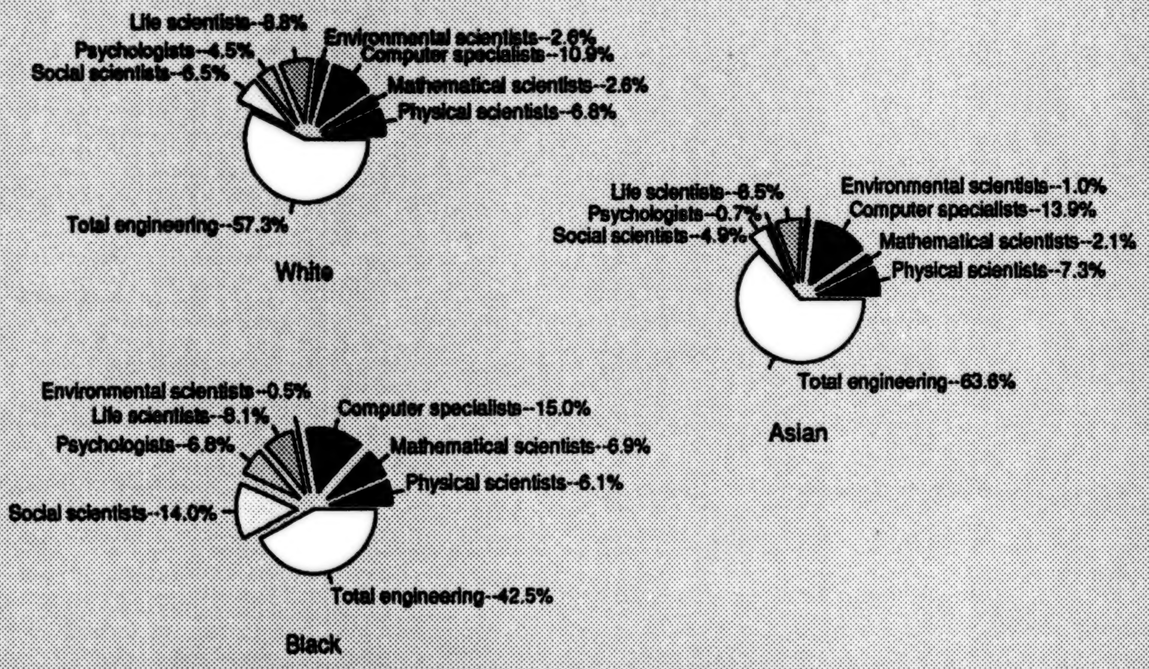
only 3 percent of those in professional fields,[21] represented almost 6 percent of all scientists and engineers. Native American scientists and engineers accounted for some what less than 1 percent of total S/E employment; this was roughly similar to their participation in the overall U.S. labor force.[22, 23]

While still significantly underrepresented, black employment in science and engineering increased much faster than did that of whites over the 1976-86 decade: 9.7-percent versus 6.2-percent average annual growth. The employment of Asians grew somewhat less rapidly at 7.3 percent per year. For the most recent 2-year period, Asian and native American S/E employment each rose at an average annual rate of 8.4 percent, while blacks and whites reported no significant change in S/E growth (9.3 percent and 6.1 percent per year, respectively).

Representation in S/E fields varied by racial groups (chart 28). Among scientists, Asians were the least likely to be employed in the environmental and behavioral sciences in 1986, while blacks were generally more likely than others to work as social scientists and life scientists. The proportions that were engineers ranged from 42 percent of blacks to 64 percent of Asians. In comparison, 57 percent of whites were engineers. Since 1976, blacks have moved away from engineering and toward the social sciences and computer specialties; among Asians, proportional increases have occurred in engineering and computer specialties.

At the doctoral level, employment of blacks and Asians increased more rapidly than that of whites. Over the 1977-87 decade, the numbers of employed black and Asian S/E doctorate-holders rose at average annual rates of 8.9 percent and 8.4 percent, respectively—more than twice the 3.7-percent rate for whites. More recently (1985-87), S/E doctorate growth has slowed; black and Asian Ph.D.'s increased at average rates of 5.5 percent and 2.7 percent per year, respectively, while the number of employed white doctorate-holders grew at about 2.5 percent annually. Despite their rapid employment growth, blacks ac-

Chart 28. Distribution of scientists and engineers employed in S/E jobs, by field and race: 1986



SOURCE: National Science Foundation, SRS; table B-10.

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[21] U.S. Department of Commerce, Bureau of the Census, *General Social and Economic Characteristics, United States Summary*, 1980 Census of Population (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, December 1983).

[22] Ibid.

[23] Data for native Americans should be viewed with caution, since the estimates for scientists and engineers and for the overall U.S. labor force are based on an individual's own classification with respect to his or her native American heritage; such perceptions may change over time.

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counted for only about 1.5 percent (6,400) of all employed doctoral scientists and engineers in 1977. This was a slight increase (1.0 percent) over 1975. The more than 36,000 employed Asians with S/E Ph.D.'s represented about 9 percent of the total in 1987, up significantly from 6 percent a decade earlier (chart 29).

hispanics in science and engineering

Hispanics are a diverse ethnic group and it would be desirable to distinguish among Mexican-Americans, Puerto Ricans, and other Hispanics, since their socioeconomic backgrounds and reasons for underrepresentation may differ. Because of data limitations, however, Hispanics must here be discussed in aggregate.

About 30 percent of the Hispanic scientists and engineers employed in 1986 were Mexican-American and 15 percent were Puerto Rican. The remaining 55 percent were either "other Hispanic"[24] or did not report their specific Hispanic origins. In the total U.S. workforce, about 61 percent of Hispanics were Mexican-American and 10 percent were Puerto Rican.[25]

Hispanics remained underrepresented in the S/E workforce in 1986, accounting for approximately 2.1 percent of the scientists and engineers then employed. In comparison, roughly 6.6 percent of all employed persons were of Hispanic origin, as were 3.3 percent of those in professional and related occupations.[26]

The S/E field distribution of Hispanics differs only slightly from that for all scientists and engineers: about 58 percent of Hispanics—and 57 percent of the total S/E workforce—were engineers in 1986. Hispanic scientists were somewhat more likely to be social scientists and less likely to be computer specialists (chart 30).

Hispanics also were underrepresented among doctoral scientists and engineers, although their proportions increased over the decade. In 1987, the 6,900 Hispanic Ph.D. scientists and engineers represented 1.7 percent of all doctoral

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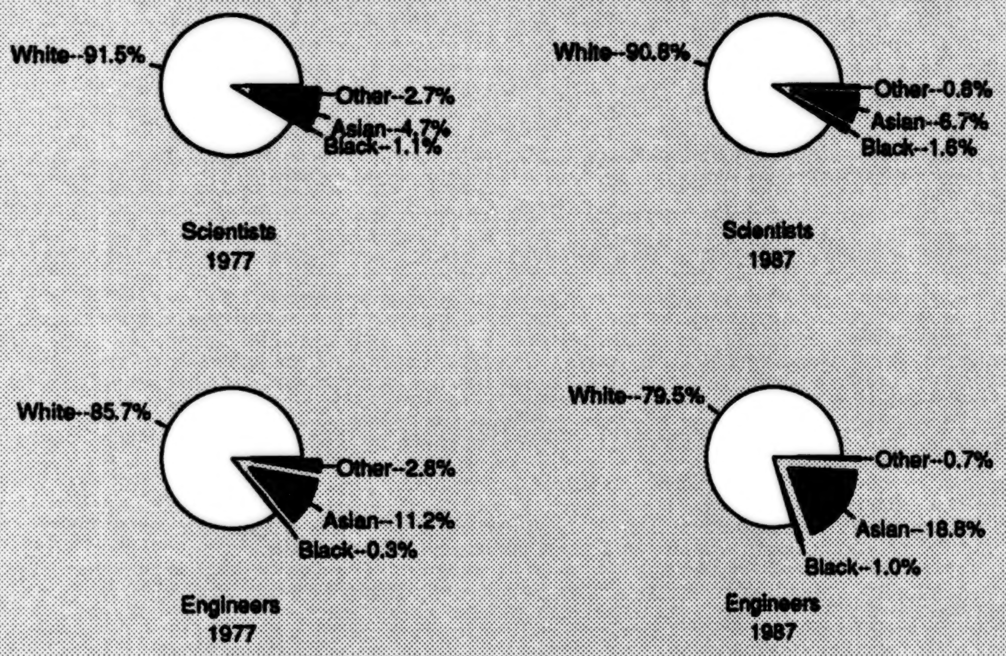
[24] The "other Hispanic" category includes individuals whose origins are in Spain or the Spanish-speaking countries of Central or South America. Also included in this category are those who identified themselves as Spanish, Spanish-American, Hispano, Latino, etc.

[25] U.S. Department of Labor, op. cit., January 1987, p. 102.

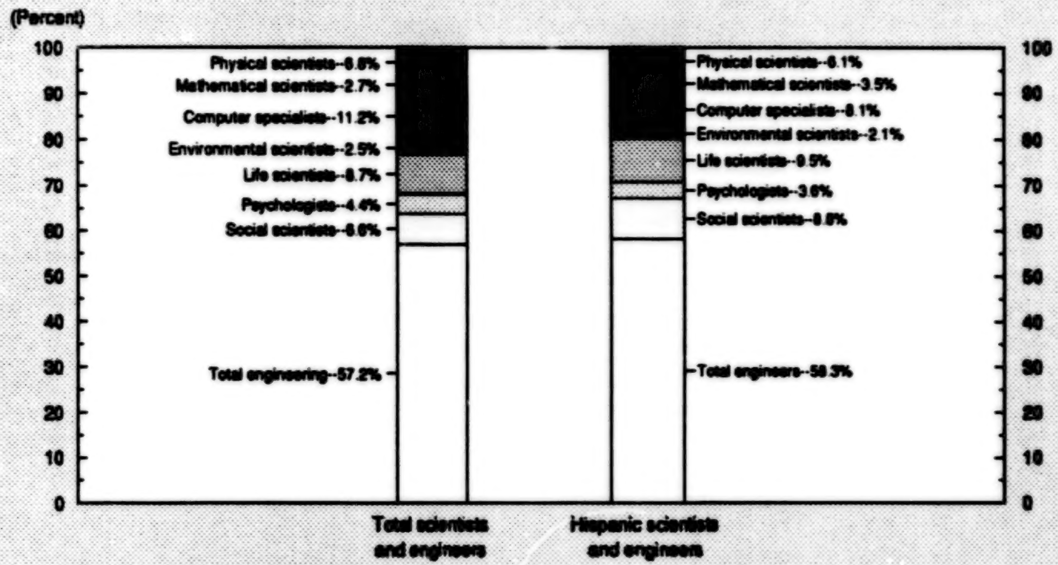
[26] Ibid., p. 179.

Chart 29. Distribution of employed doctoral scientists and engineers, by race: 1977 and 1987



SOURCE: National Science Foundation, SRS; table B-11.

Chart 30. Distribution of scientists and engineers employed in S/E jobs by field and Hispanic status: 1986



SOURCE: National Science Foundation, SRS; table B-12.

scientists and engineers, up from 2,700 (0.9 percent) in 1977. Among doctorate-holders, Hispanics were slightly more likely than all Ph.D.'s to be scientists rather than engineers.

physically disabled in science and engineering

As part of the NSF surveys underlying the employment and related data for scientists and engineers, respondents were asked if they had a physical handicap and, if so, to specify the nature of that handicap (visual, auditory, ambulatory, or other). The data for the physically disabled therefore reflect respondent self-reporting. "Disabled" is used here in place of the term "handicapped," as it has emerged as the preferred term in the United States.

Approximately 40,400 scientists and 53,800 engineers reported a physical disability in 1986. Among scientists citing a physical disability, about 25 percent each reported either an ambulatory or visual condition, while 20 percent cited an auditory disability. These proportions varied slightly for disabled engineers: about 20 percent each reported either an ambulatory or visual condition and 17 percent cited an auditory disability. The remaining scientists (30 percent) and engineers (43 percent) did not specify the nature of their disability.

Those reporting a disability are much more likely than all scientists and engineers to be outside the labor force, i.e., either not working or not looking for a job. In 1986, about 15 percent of scientists and 31 percent of engineers citing a physical disability were outside the labor force, compared to 5 percent and 6 percent[27] of all scientists and engineers, respectively.

Those reporting a physical disability were also more likely than all scientists and engineers to hold jobs in science and engineering. Of the 34,200 disabled scientists and 36,100 disabled engineers employed in 1986, 86 percent and 94 percent, respectively, were engaged in S/E activities. In comparison, less than 77 percent of all employed scientists and 92 percent of all employed engineers held S/E jobs.

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[27] National Science Foundation, *U.S. Scientists and Engineers: 1986*, Detailed Statistical Tables, NSF 87-322 (Washington, D.C., 1987), p. 29.

chapter II

labor market indicators

Statistics on S/E demographic employment trends, such as those discussed in chapter I, do not indicate whether the current personnel supply is sufficient to meet the economy's needs. Recent concerns over shortages in some engineering fields and computer specialties, and about suitable job opportunities for some scientists, suggest the usefulness of indicators in assessing S/E supply and demand conditions. Standard labor market indicators include labor force participation rates, unemployment rates, and starting salaries. In addition, S/E underemployment and underutilization rates help assess both the market for S/E jobs and the extent to which those with S/E training are utilizing their skills. While no single statistic can provide a firm basis for measuring shortages or surpluses of scientists and engineers, certain statistics, when analyzed together, allow for meaningful inferences about the condition of the S/E labor market.

Details of this analysis are described in this chapter. Overall, the employment indicators suggest that the labor market situation for scientists and engineers was favorable in 1986. For example, it can be inferred from the relatively high S/E participation rates and low S/E unemployment rates that in 1986 there was generally sufficient demand to accommodate the S/E labor force. Additionally, the moderate levels of shortages reported by industrial employers would indicate that the S/E labor force was, in general, nearly sufficient to meet the demands of the economy. This rough balance between S/E supply and demand appears to have continued into 1989, with starting salaries increasing favorably over 1986 levels and the High Technology Recruitment Index (HTRI) declining only slightly below 1986 levels.

labor force participation

The S/E labor force includes scientists and engineers who are employed—either in or out of science and engineering—and those who are unemployed but seeking employment. The labor force thus comprises those who are economically active and, consequently, directly available to carry out national efforts in science and technology. Labor force participation rates measure the fraction of the total S/E population in the labor force. Low rates would suggest that many of those with S/E training and skills are not using these skills in either S/E—or any other—jobs.

In 1986, approximately 95 percent of the S/E population was in the labor force, with scientists and engineers equally likely to be working or seeking employment. This participation rate is higher than the 82-percent[28] rate for the general population with 4 or more years of college. The variance in participation rates cannot be accounted for by differences in the respective sex compositions of the S/E and general populations. Stratification by sex shows that the participation rate for women in science and engineering was about equal to that for men (94 percent versus 95 percent), with little variation among S/E fields. In comparison, women and men in the general population who had completed 4 or more years of college had participation rates of 74 percent and 88 percent, respectively.

By S/E field, labor force participation rates vary within a narrow range, with computer specialists showing the highest rate (98.5 percent). Variations in rates primarily reflect differences in age across fields. Computer specialists are generally younger than other scientists or engineers. Many scientists and engineers not in the labor force are retired; others may be outside the labor force because of family responsibilities, poor health, or other reasons.

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[28] U.S. Department of Labor, Bureau of Labor Statistics, March 1987 supplement to the Current Population Survey, unpublished data.

unemployment rates

A standard measure of labor market conditions is the unemployment rate, which measures the proportion of those in the workforce who are not employed but seeking work. In the last decade, scientists and engineers have been improving and steadily increasing their labor market position, outperforming both the general labor force and all professional and related workers. In 1976, the unemployment rates for scientists and engineers were 4.0 percent and 2.0 percent; by 1986, these rates had fallen to 1.9 percent and 1.2 percent, respectively. In comparison, unemployment rates in 1976 were 3.2 percent for all professional and technical workers and 7.7 percent for the entire U.S. workforce. A decade later, these rates had fallen to 2.0 percent and 7.2 percent, respectively, for all professional and technical workers and the total workforce.[29]

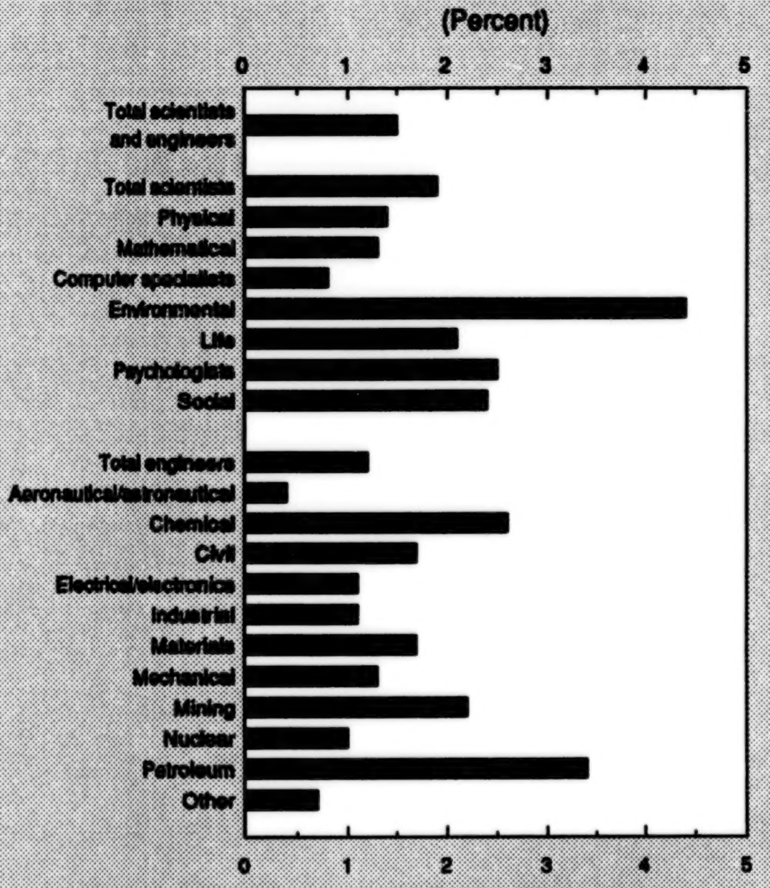
While almost all scientists and engineers who wanted jobs in 1986 were employed, the level of unemployment among the different S/E fields varied considerably (chart 31). Environmental scientists posted the highest unemployment rate of scientists and engineers (4.4 percent), while computer specialists experienced the lowest rate (0.8 percent). Among engineering occupations, petroleum engineers showed the highest unemployment rate at 3.4 percent.

s/e employment rates

The S/E employment rate measures the extent to which employed scientists or engineers have a job in science or engineering. Factors relating to non-S/E employment include lack of available S/E jobs, higher pay for non-S/E employment, location, or preference for a job outside of science or engineering.

In 1986, the S/E employment rate was 85 percent (down from 91 percent in 1976), with the rate for engineers (92 percent) substantially

Chart 31. Unemployment rates of scientists and engineers by field: 1986



SOURCE: National Science Foundation, SRS; table B-14.

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[29] U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*, Vol. 34, No. 1 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, January 1987), p. 168.

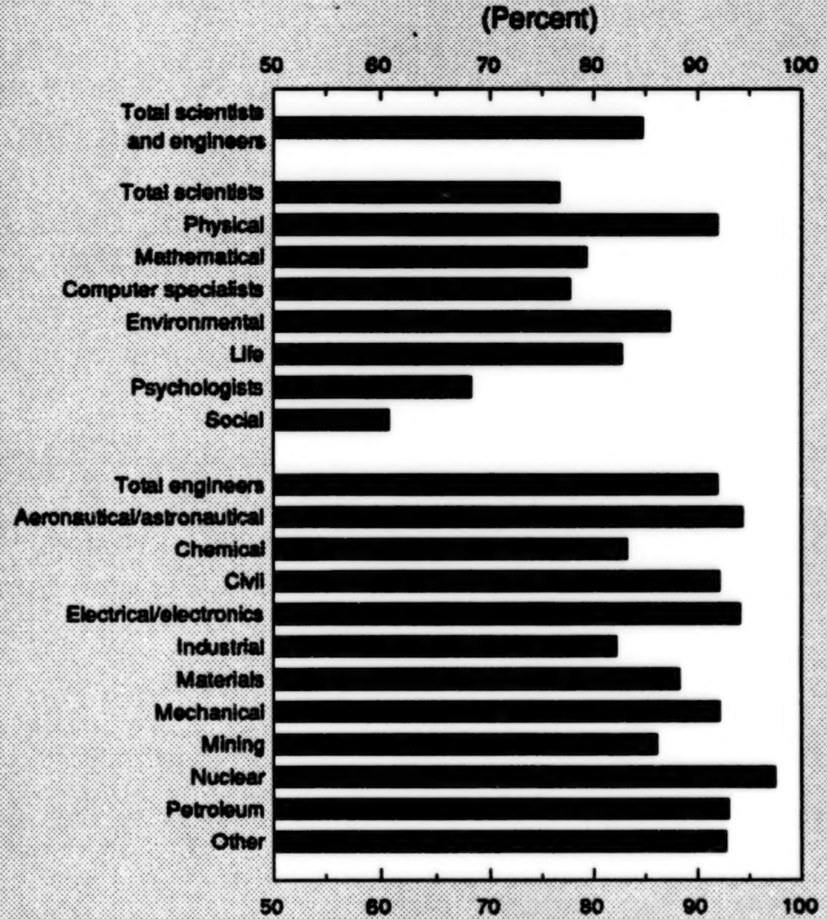
above that for scientists (77 percent) (chart 32). Within science fields, the rates ranged from a low of 61 percent in the social sciences to 87 percent each in the environmental and physical sciences. Computer specialties also had a relatively low S/E employment rate (78 percent); this suggests that a substantial number may be applying their skills to commercial activities rather than to more traditional S/E activities such as R&D.

s/e underemployment rates

Among the scientists and engineers who reported themselves as employed, some are working in non-S/E jobs or are working part time. Those S/E personnel who *involuntarily* are either working in non-S/E jobs or working part time are considered to be underemployed.

The 1986 underemployment rate for scientists and engineers (i.e., the percentage of employed scientists and engineers classified as underemployed) was 2.6 percent. Scientists were much more likely than engineers to be underemployed: 4.3 percent versus 1.0 percent. Among scientists, underemployment varied substantially by field, with social scientists and psychologists (7.2 percent and 5.7 percent) more likely than physical scientists and computer specialists (1.9 percent and 2.5 percent) to be underemployed. Underemployment among engineers ranged from 0.4 percent for nuclear engineers to 2.0 percent for petroleum engineers.

Chart 32. Science/engineering employment rates by field: 1986



SOURCE: National Science Foundation, SRS; table B-14.

s/e underutilization rates

By combining the figures for those who are unemployed and those who are underemployed and expressing the result as a percentage of the labor force, a fairly comprehensive indicator of underutilization is derived. In 1986, the underutilization rate for scientists and engineers was 4.1 percent. The rate for scientists (6.1 percent) was almost three times that for engineers (2.2 percent); among scientists, the highest underutilization rates—roughly 10 percent each—were reported for environmental and social scientists. In comparison, petroleum and chemical engineers posted the highest rates among engineering occupations, at about 5 percent each.

Note that the underutilization rate as derived here is only a partial measure, since it does not take into account the number of scientists and engineers who may have jobs requiring skills below those they actually possess.

experience of recent s/e graduates

The experience of recent S/E graduates is another indicator of the degree of labor market balance. In general, if the demand for scientists and engineers is greater than the supply at existing salary levels, the proportion of recent graduates who obtain jobs in science or engineering will be relatively high. Those proportions, however, vary considerably by field. Degree recipients are the major source of new supply to the S/E labor market.

In 1986, relatively few recent S/E graduates were unable to find employment. When 1984 and 1985 bachelor's degree recipients were surveyed, only 3.7 percent of the graduates with science degrees reported that they were unemployed in 1986, while 2.4 percent of the engineering graduates were without jobs. Within science fields, the lowest unemployment rate was recorded by those with physical science degrees (1.9 percent) and the highest rate by psychology degree-holders (5.3 percent). For those with engineering degrees, the lowest rate of unemployment was experienced in the industrial engineering subfield (0.4 percent) and the highest in petroleum engineering (8.5 percent).

Master's degree recipients in 1986 reported lower unemployment rates and somewhat different unemployment patterns than did the S/E baccalaureate recipients. Overall, unemployment rates for master's recipients in science and engineering were 2.6 percent and 1.2 percent, respectively. Among science fields, those with degrees in computer specialties recorded the lowest unemployment rate (0.4 percent); environmental sciences had the highest rate (6.1 percent). Unemployment levels varied little among the engineering specialties.

S/E employment rates for recent S/E graduates[30] with master's degrees were similar to those for more experienced scientists and engineers, while the rates for bachelor's-degree recipients were lower. The greater opportunities for S/E employment for master's degree-holders generally reflect the higher levels of investment in field-specific training; fewer S/E job openings at the bachelor's level may indicate entry-level job requirements for advanced degrees.

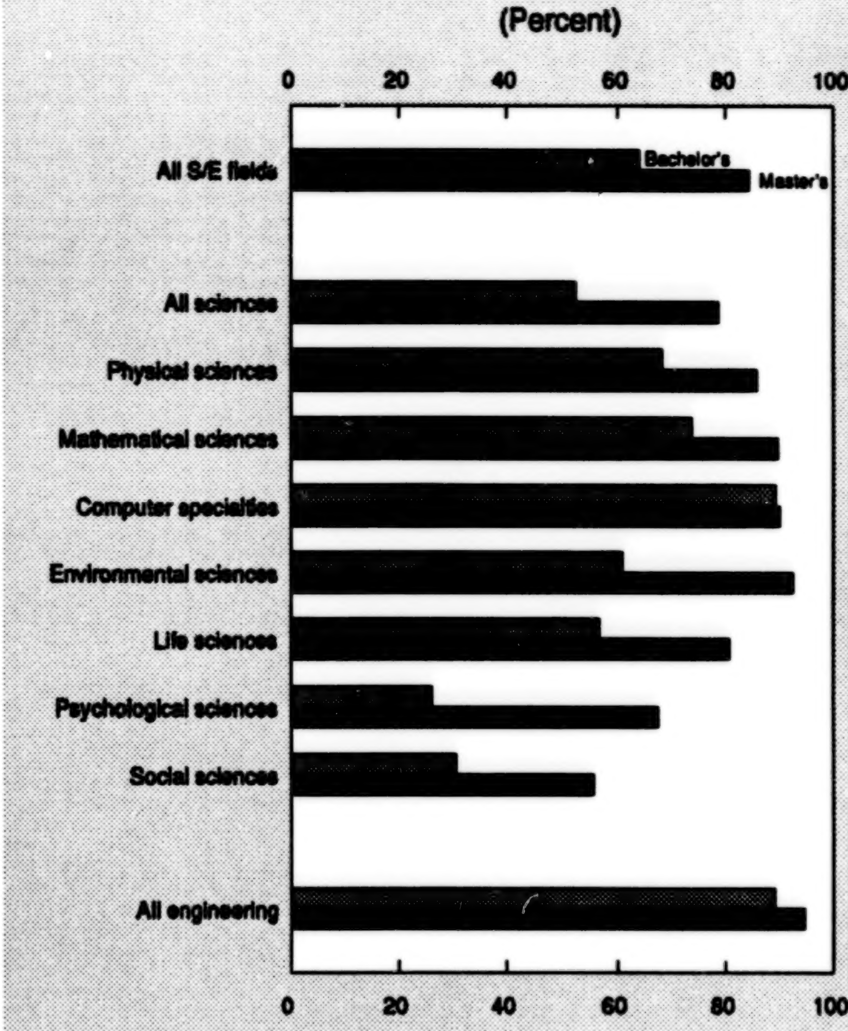


Chart 33. Percent of recent science/engineering degree recipients employed in S/E jobs: 1986

SOURCE: National Science Foundation, SRS; table B-22.

For both master's- and bachelor's-degree recipients, S/E employment rates varied between scientists and engineers (chart 33). At the master's level, 79 percent of science graduates were working in S/E occupations, while 95 percent of engineering graduates were so employed. For most science fields, almost 90 percent of those with master's degrees were employed in S/E occupations. The exceptions to this were the life sciences (81 percent) and social sciences (56 percent). Although rates were lower for bachelor's-degree recipients, the same general pattern prevailed: the average rate for engineers (89 percent) was substantially higher than that for scientists (53 percent), and the lowest employment rate was recorded by social scientists (31 percent).

S/E employment rates for men were generally higher than those for women at both the bachelor's- and master's-degree levels. The concentrations of each sex in particular fields contributed to some of the difference in these rates. The low S/E employment rate in psychology and the social sciences, coupled with the concentration of women in these fields, effectively lowered the average S/E employment rate for women. On the other hand, the high S/E employment rate in engineering—a field dominated by men—had the effect of raising men's average rate. Substantial field mobility can be identified at entry to the labor market. This characteristic derives from supply/demand adjustments and flexibility of S/E personnel. In 1986, for example, 30 percent of the recent bachelor's and 23 percent of recent master's graduates working as computer specialists did not receive their degrees in computer science (chart 34). Rather, graduates in mathematics, engineering, and the social sciences, responding to the job opportunities in computer specialties, accounted for the majority of influx from other S/E fields.

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[30] Data for new entrants are from National Science Foundation, *Characteristics of Recent Science and Engineering Graduates*: 1986, Detailed Statistical Tables, NSF 87-321 (Washington, D.C., 1987).

In 1986, roughly 20 percent of recent recipients of S/E bachelor's degrees were enrolled in full-time graduate programs, and an additional 11 percent were enrolled on a part-time basis; corresponding rates among master's-degree recipients were 21 percent and 9 percent, respectively. Graduate enrollment seems inversely related to employment demand. For example, relatively low graduate enrollment rates were observed in such high-demand fields as mathematics, computer science, and engineering. Fields with lower employment demand—such as the life and social sciences—had higher enrollment rates.

other indicators

shortages of s/e personnel

Another direct indicator of S/E labor market supply and demand imbalances is the reported experience of employers in meeting their staffing requirements. Nearly 46 percent of firms in major S/E-employing industries reported shortages in one or more S/E fields, according to a January 1989 NSF survey of industrial establishments.

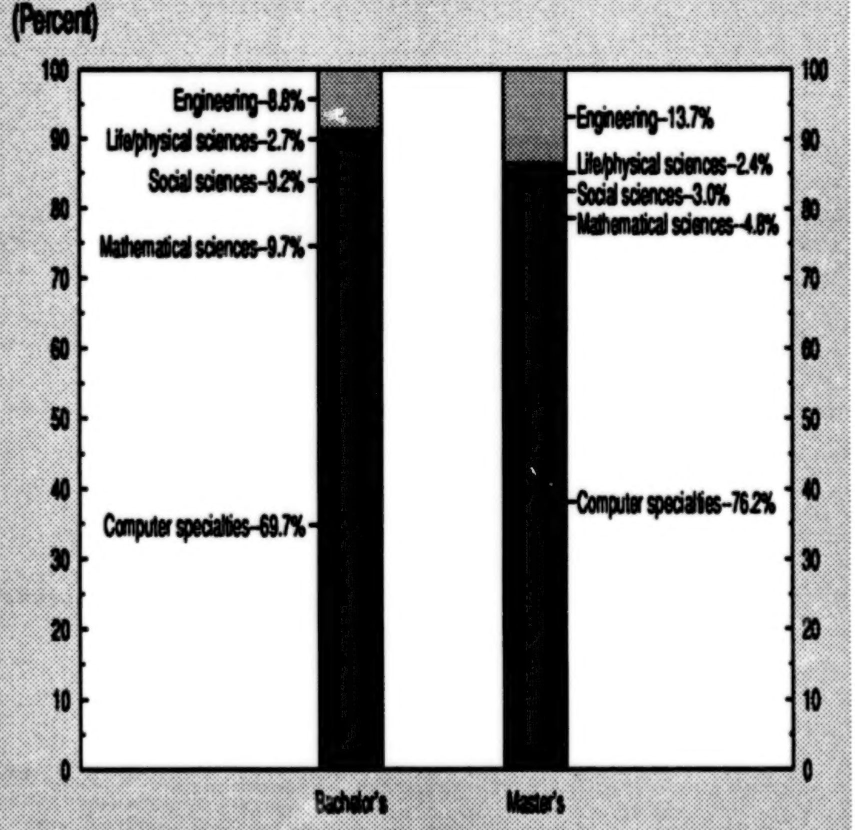
S/E fields with the highest reported levels of shortages were:

- Electronics engineering—22 percent of employers reporting;
- Chemistry—21 percent;
- Electrical engineering, computer engineering, and computer science—20 percent each; and
- Chemical engineering—18 percent.

Across all fields, 80 percent of the employers of scientists, and 75 percent of the employers of engineers, reported plans to hire experienced personnel rather than new college graduates, indicating that the supply of new graduates is less of a problem.[31] Overall, the equilibrium between S/E supply and demand has improved since the beginning of the 1980s, when one-half or more of employers of most engineering and computer specialties fields reported shortages.[32]

Engineering schools in the United States have reported what may be considered serious and persistent shortages of faculty. In 1986, almost 9 percent of authorized full-time engineering faculty positions were unfilled; many institutions reported that the authorized levels would be higher if it were possible to fill such positions.[33] Shortages of engineering faculty are linked to both the long-term decline in engineering doctorates awarded to U.S. citizens and the increasing demand for engineering Ph.D.-holders in the industrial sector.[34]

Chart 34. Degree field of 1984 and 1985 science and engineering graduates working as computer specialists in 1986



SOURCE: National Science Foundation, SRS; table B-23.

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[31] Applied Managment Sciences, Inc., NSF Quick Response Survey, January 1989, unpublished data.

[32] National Science Foundation, "Labor Markets for New Science and Engineering Graduates in Private Industry," *Science Resources Studies Highlights*, NSF 82-310 (Washington, D.C., 1982).

[33] National Science Foundation, *Young and Senior Science and Engineering Faculty and Nonfaculty Research Doctorates: 1986*, forthcoming.

[34] National Science Board, *Science & Engineering Indicators— 1987*, NSB 87-1 (Washington, D.C.: National Science Foundation, 1988), p. 66.

trends in s/e starting salaries

Changes in salaries, especially starting salaries, serve as a valuable indicator of labor market conditions. If personnel for certain S/E fields are in short supply, their salary increases can be expected to exceed those in fields where the supply of available S/E workers is in balance with or exceeds demand; this is especially true for new labor force entrants.

Among major science fields, starting salary offers made in 1989 to recent baccalaureates ranged from about $2,500 a month for computer science majors (3 percent above 1988 levels and 14 percent above 1986 levels) to $1,750 a month for biological science majors (no change from 1988 levels and 10 percent above 1986 levels). Agricultural sciences showed the largest average increase in starting salary offers between 1988 and 1989 — over 7 percent (13 percent above 1986 levels).

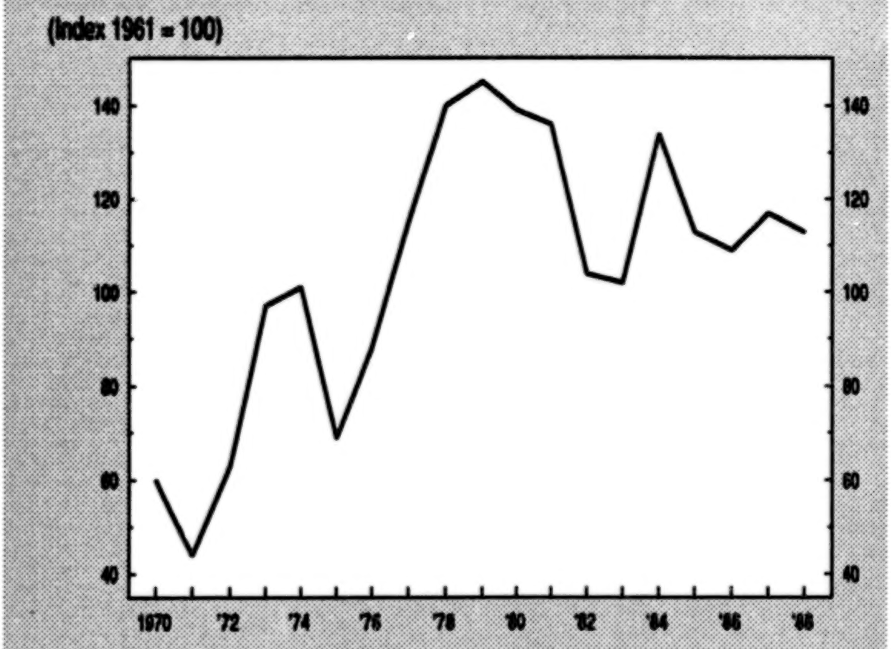
In most engineering fields, starting salary offers to recent bachelor's-degree recipients increased slightly between 1986 and 1987, and more substantially between 1987 and 1988.[35] In 1989, petroleum and chemical engineering commanded the highest starting salaries (about $2,750 a month each), up 2.9 percent and 6.3 percent, respectively, from 1988 levels. Increases in starting salaries to recent graduates in other engineering fields ranged from 3.3 percent for electrical engineering to 5.1 percent for civil engineering between 1988 and 1989.

high-technology recruitment index

The High-Technology Recruitment Index (HTRI) is another indicator of S/E labor market conditions. The HTRI measures the amount of advertising space devoted to recruiting scientists and engineers. In 1975, the index measured 69. By 1979, it had risen to a peak of 145, reflecting the surge in S/E recruitment which occurred toward the end of that decade. Following the recession in the early eighties, the HTRI dropped to 102 in 1983, before recovering strongly to 134 in 1984.

In the last 5 years, the HTRI has gradually declined, registering [illegible] in the second quarter of 1989—the lowest level of activity since 1983 (chart 35).

Chart 35. Deutsch, Shea, and Evans high technology recruitment index: 1970-88



SOURCE: National Science Foundation, SRS; table B-17.

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[35] College Placement Council, "CPU Salary Survey," Formal Report No. 3 (Bethlehem, Pa., July 1989), p. 2.

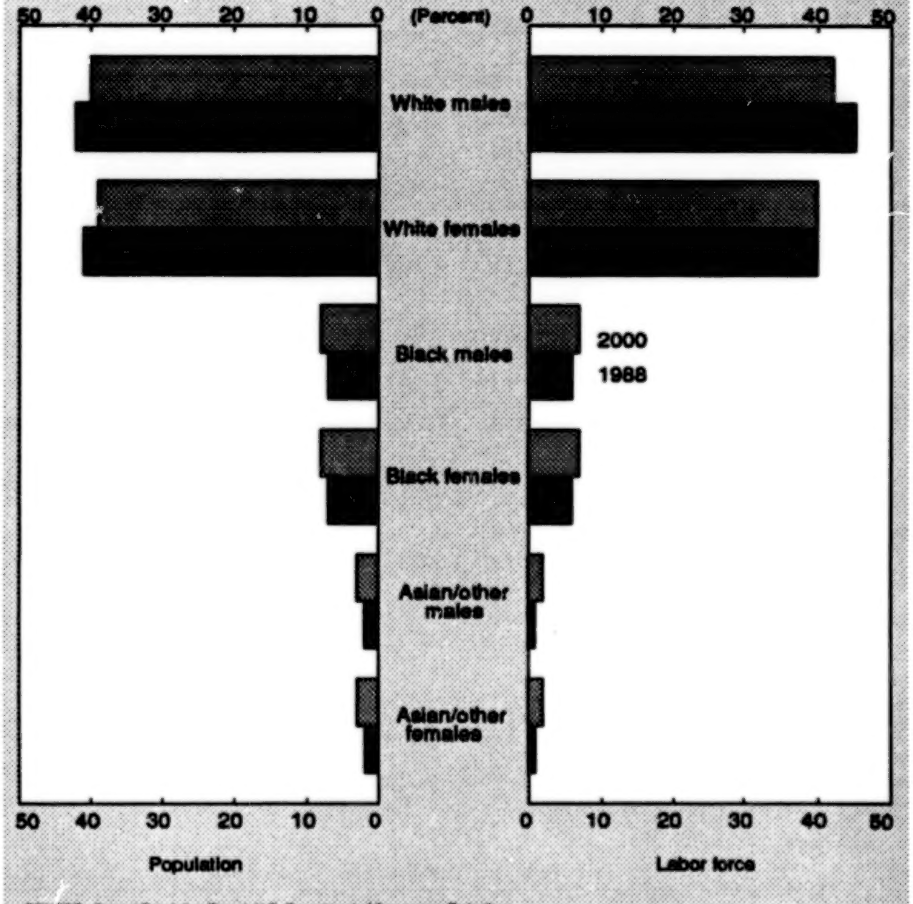
chapter III

the dynamics of s/e labor markets

Looking ahead to the 1990s, substantial changes are expected to affect both the supply and demand of scientists and engineers. On the demand side, there are two major factors to be considered. The first is the need for new workers; this need stems from economic growth, changing technology, and competitive challenges. The second factor is the need to replace workers who leave the S/E workforce because of death, retirement, transfer to other occupations, and emigration. While future required increases in new S/E workers are expected to be at lower levels of growth than in the early and mid-1980s, employers will need larger numbers of replacements to counteract the attrition rate of the overall expanding S/E labor force.

On the supply side, a declining college-age population—which has already resulted in a falling rate of growth in S/E baccalaureates—has raised concerns as to the impact on future levels of new S/E graduates. Another factor affecting the future supply of new S/E graduates is a change in the ethnic and gender mix of the college-age population. In the future, this population will have higher proportions of minorities and women (chart 36)—groups which, until now, have had relatively low participation rates in S/E

Chart 36. Percent distribution of 20-24 year old population and labor force by sex and race: 1988 and projected 2000



SOURCE: Current Population Report, U.S. Department of Commerce, Projections of the U.S., by age, sex, and race, 1988-2080, March 1989, Bureau of Labor Statistics, U.S. Department of Labor, and National Science Foundation, SRS.

education.[36] These and other factors affecting the supply and demand for scientists and engineers will determine the eventual future balance of the S/E labor market.

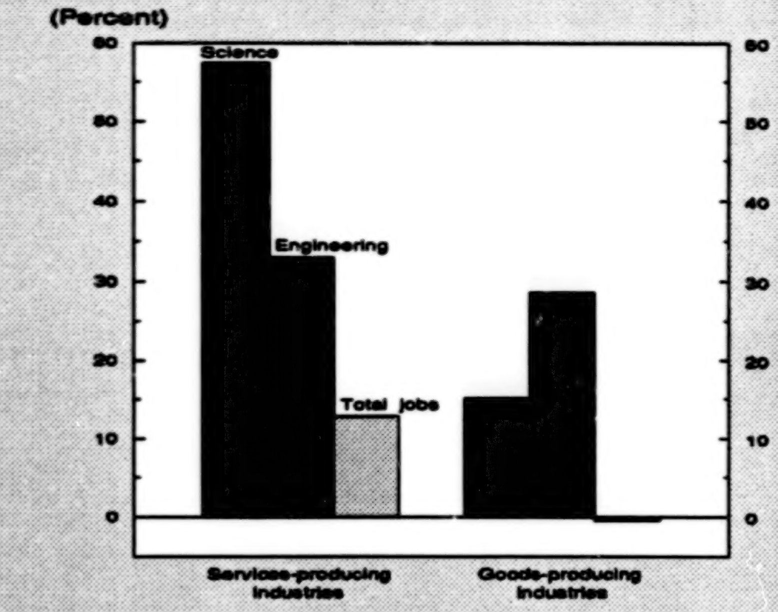
This chapter first examines projected growth of S/E jobs in the industrial sector, which forms the core of demand for S/E occupations (about two-thirds of total S/E employment). Information on the S/E pipeline is presented next, including an examination of S/E degree production patterns in the 1980s. Next is a detailed analysis of the flows into and out of the S/E workforce and the relative contributions of these flows to S/E supply/demand labor market balances. The chapter concludes with a synopsis of the supply/demand outlook for science and engineering.

projected industry s/e demand

Over the 1988-2000 period, almost 600,000 additional jobs for scientists and engineers are expected to be created in U.S. private industry.[37] The relative S/E employment change is projected to increase by over 33 percent; this is nearly four times the projection for the total industrial labor force (chart 37). Despite this substantial growth, the projected gains in S/E requirements should not match past increases. This is because of the overall slowdown of labor force, total employment, and GNP growth expected in the 1990s (appendix A, table A-5).

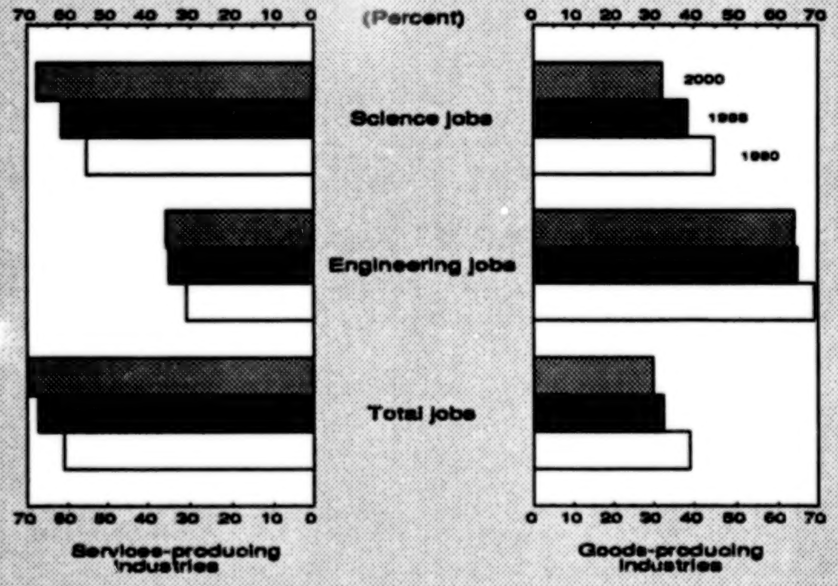
Three-fifths of the increase in S/E jobs is projected to be in the services-producing sector. Consequently, the 2.5-million S/E jobs in the year 2000 are expected to be somewhat more concentrated in this sector than were the 1.9-million S/E jobs in 1988. The faster creation of S/E jobs in the services-producing sector continues a trend first observed in 1980. At the projected rates of growth, the proportion of science jobs in the services-producing industries would increase from 62 percent in 1988 to almost 68 percent by 2000; the percentage of engineering jobs would go from 35 percent to 36 percent during this period (chart 38).

Chart 37. Projected increase in science, engineering, and total jobs in private industry: 1988-2000



SOURCE: National Science Foundation, SRS; table B-18.

Chart 38. Proportion of science, engineering and total jobs in private industry, by sector: 1980, 1988 and projected 2000



SOURCE: National Science Foundation, SRS; table B-18.

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[36] National Science Foundation, *Women and Minorities in Science and Engineering*, op. cit., p. 29.

[37] See appendix A for details on projection scenarios and methodology.

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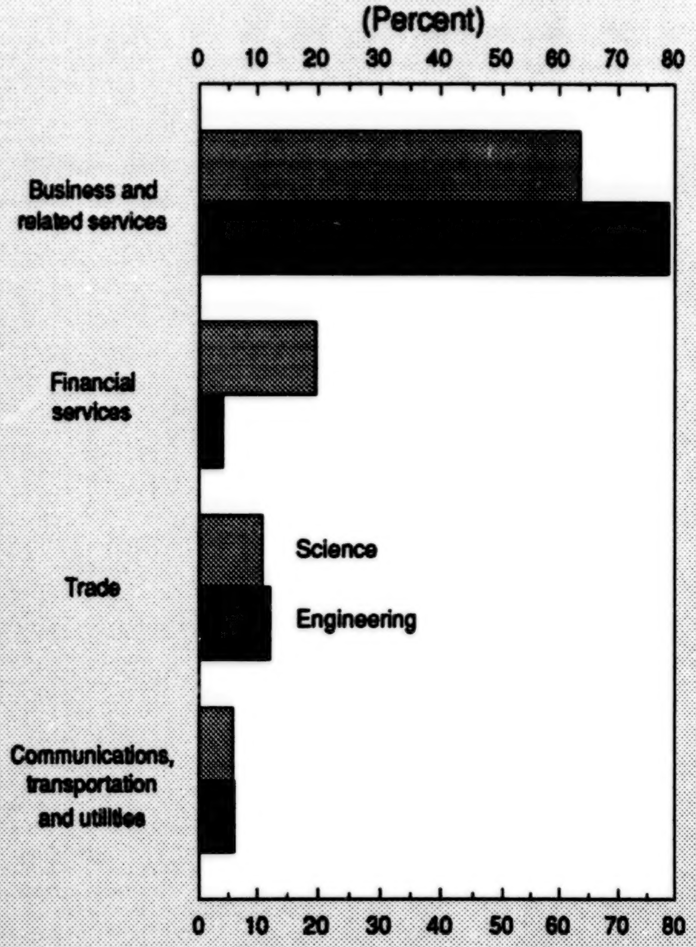
services-producing industries

Total job growth is expected to be very strong for almost all of the services-producing industries through the year 2000. By 2000, services-producing employment should constitute about 70 percent of all private industry jobs. Almost 7 million new jobs are projected to be added to the sector between 1988 and 2000.

Jobs for scientists and engineers are expected to grow even faster, not only because of the general growth in overall employment requirements, but also because of their increasing share of that employment. Total employment in services-producing industries is projected to be about 13 percent higher in 2000 than in 1988; the sector's S/E employment is expected to increase by almost 44 percent. The proportion of the services-producing workforce in S/E jobs is projected to increase during this time from 1.6 percent in 1988 to 2.0 percent by 2000, providing jobs for approximately 550,000 scientists and 600,000 engineers.

Business and related services will be the sector's chief provider of new S/E jobs through the year 2000; about two-thirds of the new science positions and three-quarters of the new engineering jobs expected to be created in the services-producing sector will be generated in this division (chart 39). Overall, the number of S/E positions in the business and related services industries is expected to rise by over 65 percent to about 740,000—this will represent 64 percent of the sector's total S/E jobs in the year 2000.

Chart 39. Percent distribution of new science and engineering jobs to be created in services-producing industries: 1988-2000



SOURCE: National Science Foundation, SRS; table B-18.

The need for systems design and analysis and software development should continue to be critical, reflecting the increasing demand for specialized systems as well as the proliferation of packaged software to meet a broad range of user requirements. The Bureau of Labor Statistics projects that heavy investment in computer-assisted design and manufacturing techniques will lead to a continuing rise in demand for computer specialists.[38] In addition, the development of new services should keep demand for the services of independent research laboratories and of management and other consulting firms very strong. Finally, S/E job opportunities in engineering and architectural services firms are expected to turn around from declines caused by the recent low demand of a principal customer, the nonresidential construction industry. This latter industry is projected to recover from the current oversupply of office and commercial space, and will resume modest growth.

S/E jobs in the financial services division should continue to grow faster than in most other industries. As the growth in demand for financial services proceeds unabated, S/E jobs are expected to increase from 122,000 in 1988 to almost 168,000 in 2000.

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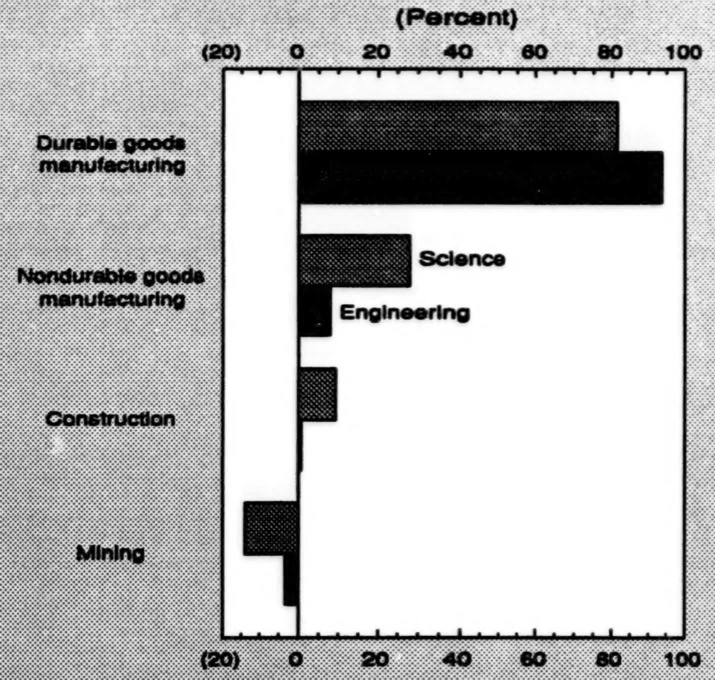
[38] For an analysis of long-range economic trends and their projected impact on employment, see Valerie A. Personick, "Industry Output and Employment: A Slower Trend for the Nineties," *Monthly Labor Review*, November 1989, pp. 25-41.

goods-producing industries

The goods-producing industries are projected to provide almost 1.1 million jobs for engineers and 270,000 jobs for scientists in the year 2000. Similar to the trend observed between 1980 and 1988, there will be little, if any, growth in the sector's total employment. Small growth in the construction and durable goods manufacturing industries will be partially offset by declines in mining and nondurable goods manufacturing. Nevertheless, growth in the output of most manufacturing industries is expected to continue at near current rates even without a concurrent growth of, or with declines in, total employment. Manufacturing output growth is predicated on both investment leading to higher productivity of the manufacturing workforce and on the improving quality of services purchased from the services-producing sector.[39]

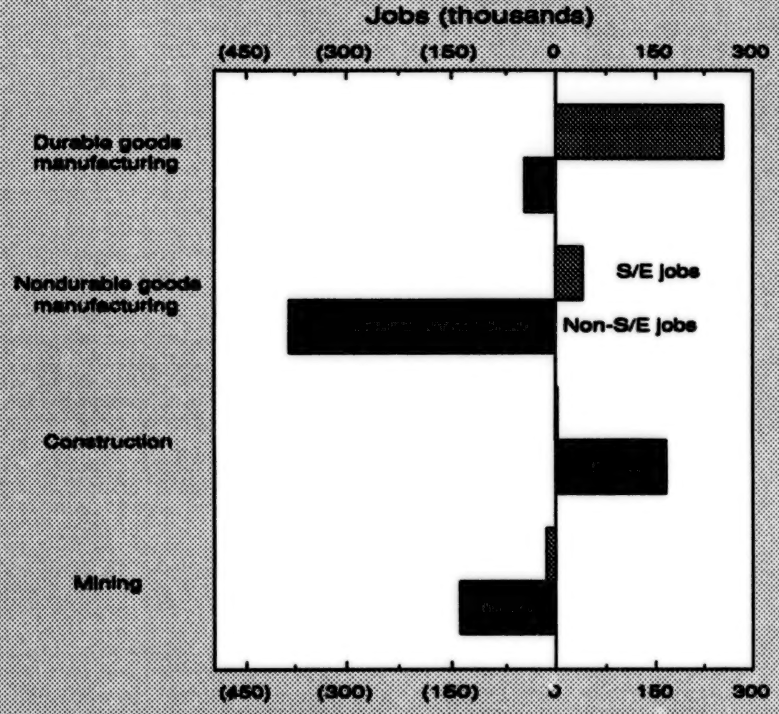
Most of the increase in the sector's S/E personnel employment should be in durable goods manufacturing (chart 40). While employment in non-S/E occupations in this division is projected to decline slightly over the 12-year period, S/E jobs are expected to rise by 256,000 or 32 percent (chart 41). Nondurable goods industries are projected to lose a substantial number of non-S/E jobs. Due to occupational restructuring, however, S/E employment should increase by about 12 percent.

Chart 40. Percent distribution of new science engineering jobs to be created in goods-producing industries: 1988-2000



SOURCE: National Science Foundation, SRS; table B-18.

Chart 41. Projected change in number of S/E and non-S/E jobs in goods-producing industries: 1988-2000



SOURCE: National Science Foundation, SRS; table B-18.

occupational employment trends

During the 1988-2000 period, the occupational composition of industry jobs is expected to shift away from production and assembly-line jobs toward professional, managerial, and technical occupations. While business and industry as a

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[39] Larry Hirschhorn, *Skill Formation in the U.S. Service Economy* (Philadelphia, Pa.: Wharton Center for Applied Research, University of Pennsylvania, April 1987), p.9.

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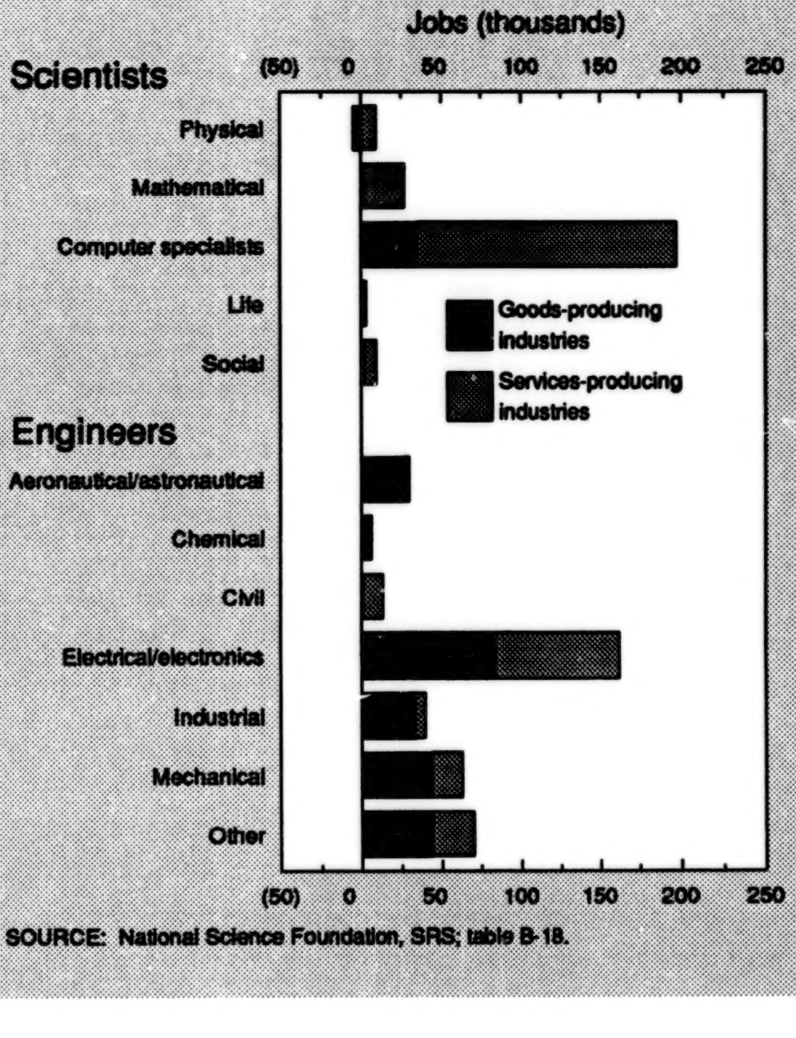
whole is expected to provide approximately 9 percent more jobs between 1988 and 2000, employment opportunities for S/E jobs are projected to increase by about 34 percent. This increase in S/E jobs is in part because of general requirements for a higher proportion of workers with more education than in the past and because the need to remain competitive will require an increasing number of S/E workers to update product designs, explore more cost-effective technology of producing goods, and develop new products.[40]

The S/E occupation benefitting most from these trends has been and should continue to be that of computer specialist. It is expected to have the largest employment gain (197,000 jobs) and the fastest growth (62 percent) of any S/E occupation (chart 42). About one-half of the employment gain for computer specialists is projected to occur in the business services division, primarily in computer and data processing services. The remaining increase should be spread throughout industry as computers continue to be used more intensively by more industrial employers. New business and defense computer applications should continue to be primary sources of requirements for computer specialists.

Chart 42. Projected change in number of S/E jobs in private industry, by occupation and sector: 1988-2000



SOURCE: National Science Foundation, SRS; table B-18.

Electrical/electronics engineering is projected to have the next biggest absolute and relative employment gain, up by 162,000 jobs or by nearly 40 percent. This increase is expected to be divided almost equally between the goods-producing and services-producing sectors, with increases of 84,000 and 78,000, respectively. These engineering jobs should be primarily in the manufacturing industries producing communications equipment, computers, and other electronics equipment; and in the engineering and architectural services firms servicing these industries.

s/e supply—the pipeline

The S/E pipeline begins with a student's precollege experience. High school mathematics and science courses and performance on standardized tests measuring quantitative ability largely determine a student's likelihood of entering college S/E degree programs. Thereafter, new entrants to S/E employment depend on degree production in S/E fields and on the decisions of S/E degree recipients to pursue occupations in science and engineering.

precollege science and mathematics

The decision to pursue an undergraduate S/E program—and, subsequently, an S/E career—is influenced significantly by exposure to precollege science and mathematics courses. These provide a grounding in the basic principles needed to complete S/E undergraduate programs. For example, of high school sophomores in 1980 who graduated in 1982, more than two-thirds had taken three or more mathematics courses, while less than one-half had taken more than two science courses.[41]

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[40] For an excellent discussion of the economic factors affecting occupational pattern changes, see G.T. Silvestri and J.M. Lukasiewicz, "Projections of Occupational Employment, 1988-2000," *Monthly Labor Review*, November 1989, pp. 42-65. Also see Personick, op. cit.

[41] National Science Foundation, *Women and Minorities in Science and Engineering*, NSF 86-301 (Washington, D.C., January 1986).

A significant factor in determining the extent and type of science and mathematics courses selected is curriculum placement. Students pursuing an academic track (versus general or occupational tracks) tend to elect more advanced mathematics courses in geometry and algebra and are more likely than other students to take chemistry, physics, and biology. Between 1981 and 1985, the share of college-bound seniors choosing academic-track programs increased 2.0 percentage points to 78.5 percent.[42]

The Scholastic Aptitude Test (SAT) attempts to measure precollege skill attainment and is widely used by colleges in admissions decisions. Students who intend to major in science or engineering generally score much higher on both the math and verbal portions of the SAT than do all students taking these tests. Between 1977 and 1986, mean SAT scores for students intending to pursue S/E majors have been relatively level; quantitative scores ranged between 507 and 517 and verbal scores from 444 to 454. In comparison, mean math SAT scores for all college-bound seniors ranged between 467 and 475 during this period, and verbal scores between 424 and 431.

s/e degree production

Approximately 290,000 S/E baccalaureates were awarded annually in the United States during the 1970s, followed by about 2-percent annual growth in the eighties. In 1986, about 324,000 S/E bachelor's degrees were awarded. Since 1980, the field distribution of S/E baccalaureates has changed significantly, favoring degrees in engineering and mathematical sciences (primarily computer science degrees); concurrently, degree production in the life and social sciences show the greatest declines (chart 43).

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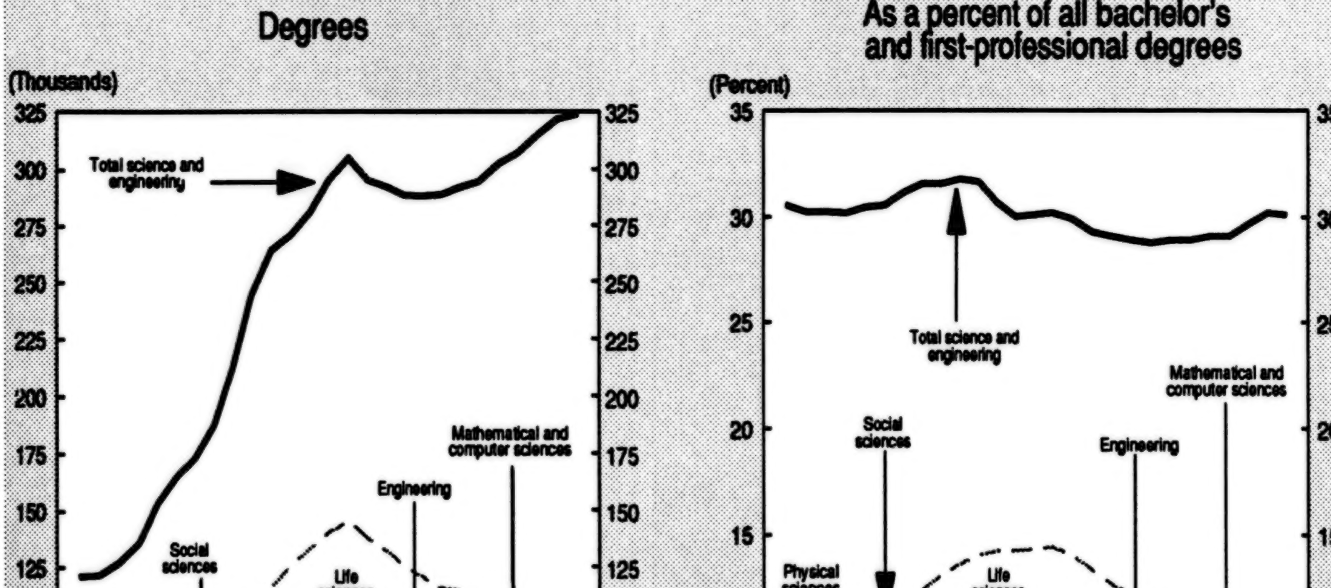
[42] Admissions Testing Program at the College Board, *Profiles, College-Bound Seniors*, 1981-1985, annual series (New York, N.T.: College Entrance Examination Board).

Chart 43: Science and engineering bachelor's and first-professional degrees awarded, by field: 1960-86



SOURCE: National Science Foundation, SRS; table B-19.

The number of S/E master's degrees increased steadily through the midseventies, declined somewhat in the late seventies, then rose sharply in 1982. By 1986, an all-time high of more than 62,500 students were graduated with master's degrees in S/E fields (chart 44).

In 1972, the number of S/E doctorates peaked at 19,000, then declined steadily until leveling out at slightly over 17,000 in 1978. Since then, however, the number of S/E doctoral degrees awarded has increased almost annually (chart 45). In 1988, roughly 20,300 S/E doctorates were awarded, representing 61 percent of all doctorates. Ph.D. growth in engineering (4,190 degrees in 1988) and the physical sciences (4,046 degrees) has contributed most significantly to the rise in S/E doctorates since 1982. In fact, the 13-percent annual increase in engineering doctorates reported for 1988 represented the eighth consecutive year of growth in this field. Doctorates awarded in the social sciences (5,637 degrees) declined 2 percent, while the life sciences (5,121 degrees) and mathematical and computer science combined (1,263) registered gains of 6 percent each. Doctorates awarded in the physical sciences increased by 5.4 percent between 1987 and 1988.

All of the growth in the number of S/E doctorates awarded since 1978 is accounted for by rapid increases in the number of foreign graduate students receiving such degrees. The number of U.S. citizens receiving S/E doctorates has declined somewhat since 1978. Foreign students received 49 percent of all doctorates in engineering in 1988 and 27 percent in the sciences, compared to 35 percent and 15 percent, respectively, in 1978[43] (table 1).

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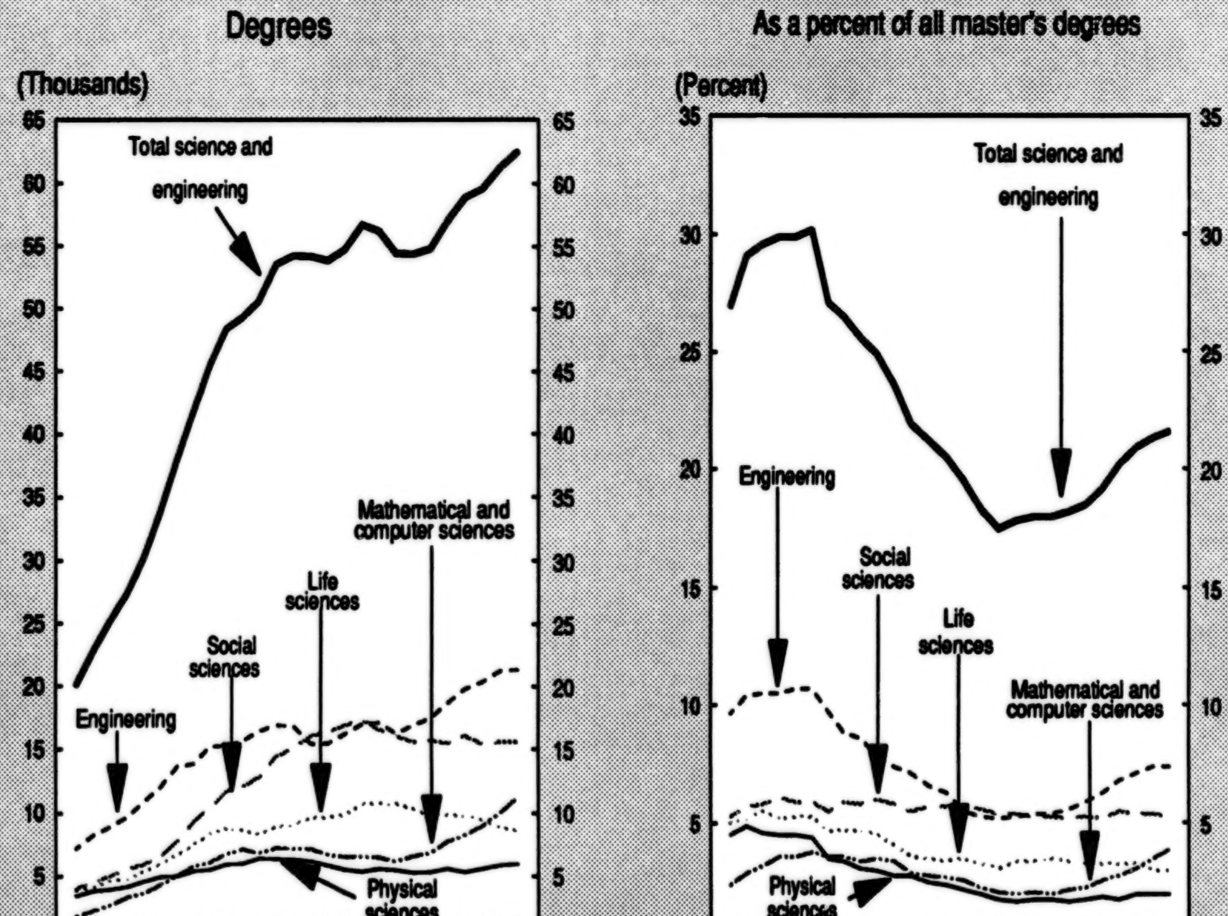
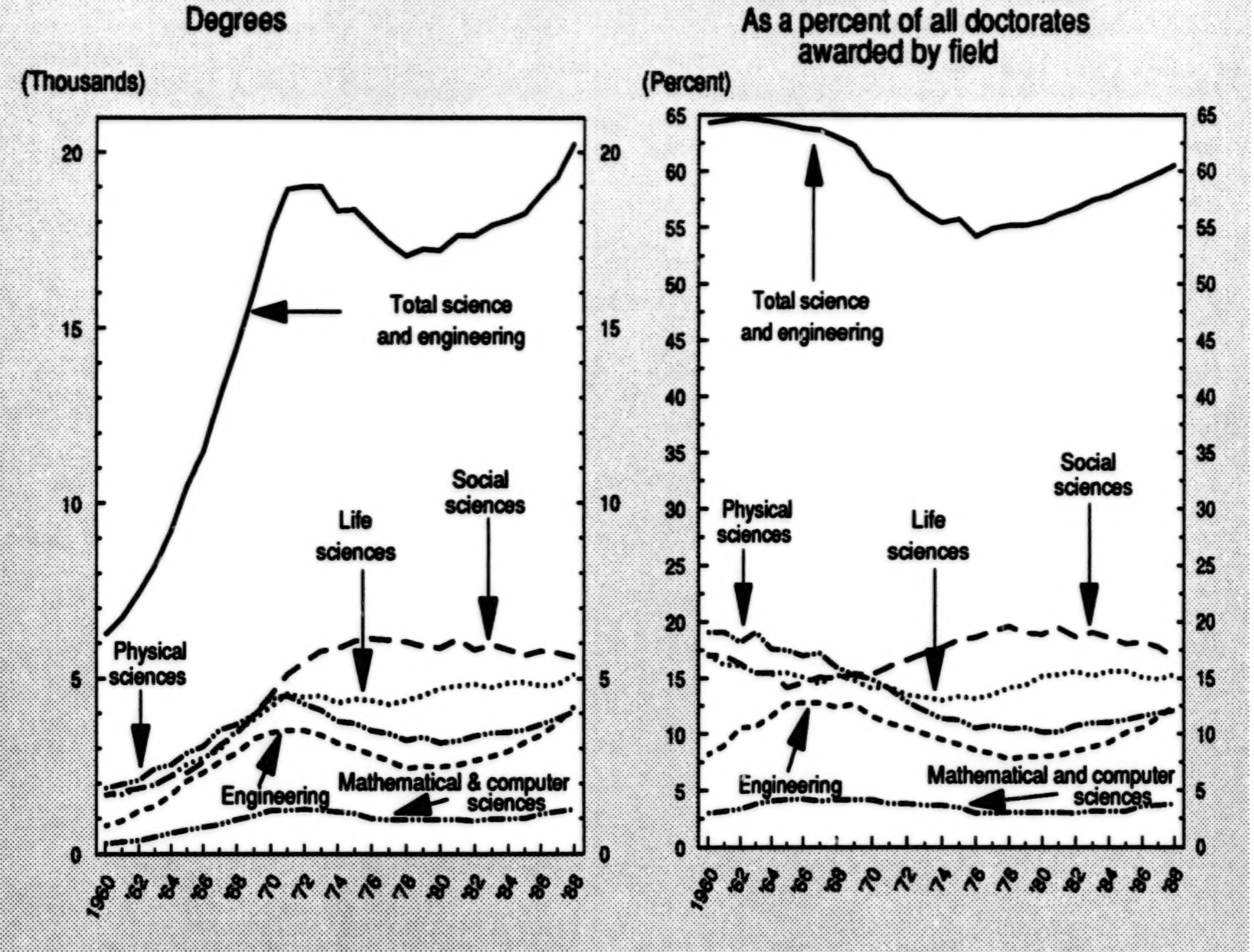
[43] National Science Foundation, *Science and Engineering Doctorates: 1960-86*, Detailed Statistical Tables, NSF 88-309 (Washington, D.C., 1988).

Chart 44: Science and engineering master's degrees, by field: 1960-86



SOURCE: National Science Foundation, SRS; table B-20.

Chart 45. Science and engineering doctorates awarded, by field: 1960-88



SOURCE: National Science Foundation, SRS; table B-21.

Table 1. Proportion of science/engineering doctoral degrees awarded to foreign citizens: 1975-88

Year	Science	Engineering
	—Percent—	
1975	14.6	28.9
1976	14.1	31.3
1977	14.8	32.0
1978	14.7	34.5
1979	14.8	35.1
1980	14.7	37.3
1981	15.9	41.8
1982	17.3	44.6
1983	17.7	46.7
1984	19.2	48.1
1985	21.0	49.7
1986	23.4	48.9
1987	24.9	48.5
1988	26.6	48.8

Source: National Science Foundation, SRS, appendix table B-21

sources of flow in the s/e labor market

The flows of S/E workers[44] in and out of the labor force, and among specialties within it, generally serve as balancing forces in the market place by providing the self-correcting mechanisms needed to adjust the balance between supply and demand. While S/E degree recipients are the major source of supply to S/E labor markets, they are not the only source of entrants into the S/E workforce. Other direct sources of flow into and out of the S/E workforce include persons reentering S/E work, immigration, transfers from other occupations and separations from the S/E workforce. To illustrate the relative impact of these and other potential adjustments on the overall supply of scientists and engineers, it is useful to examine past S/E labor market flows. The following discussion identifies various components of the labor market inflows and outflows between 1985 and 1986 and analyzes their relative importance to the stock of scientists and engineers.

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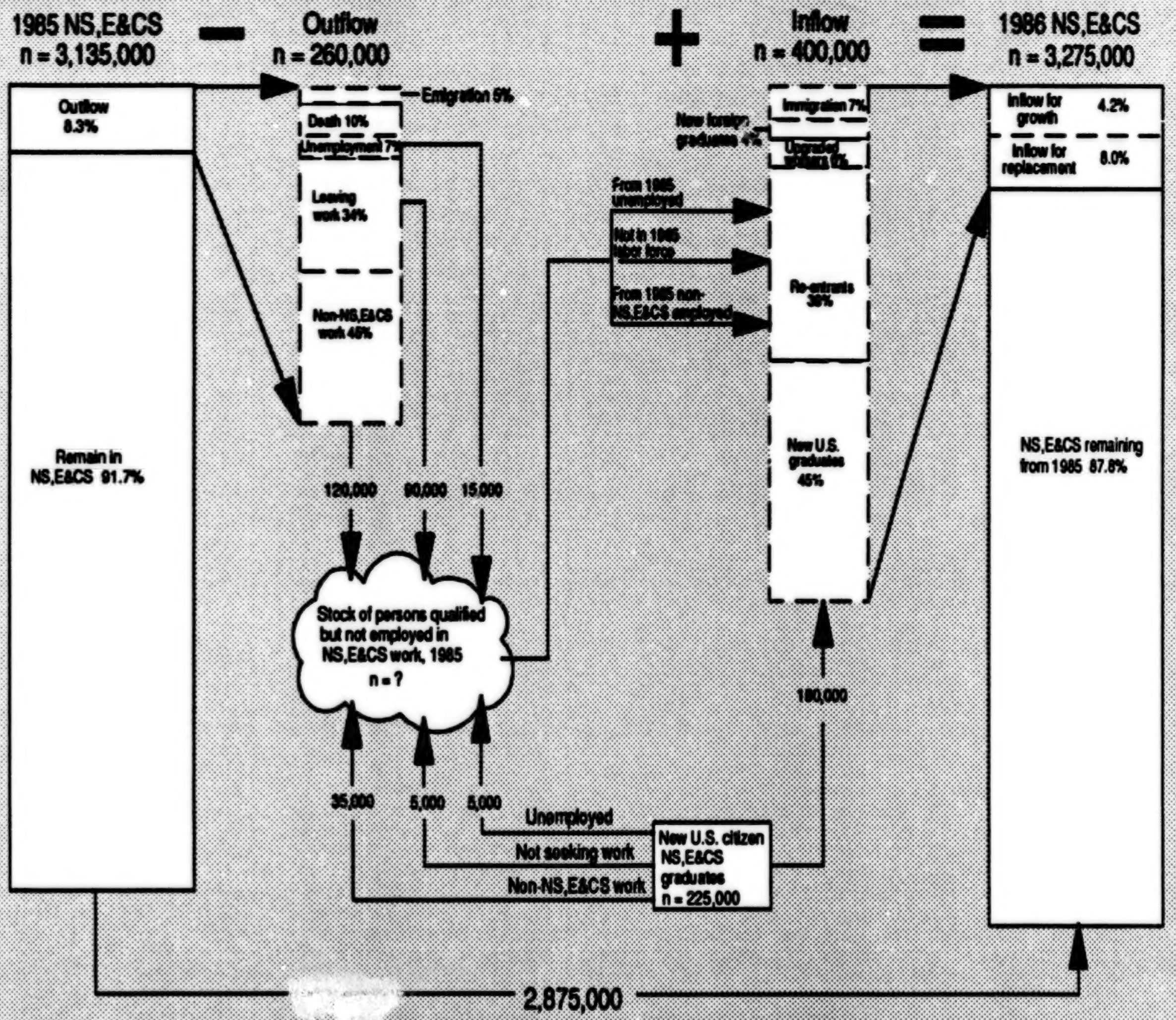
[44] The terms "S/E employment" "S/E jobs," and "S/E workers" as used here refer to persons employed in scientist and engineer jobs. "Scientists and engineers not employed in science and engineering" describes those persons who are professionally qualified to hold S/E jobs by virtue of their education, training, and work experience, but who are either employed in non-S/E jobs or not in the labor force.

Given the many forces affecting them, the flows of scientists and engineers into and out of the S/E workforce are quite complex. Additionally, there are not always concurrent, comparable data on all segments comprising new supply of and attrition from S/E employment. To approximate the magnitudes of S/E flows and their relative contributions to the overall stock of scientists and engineers, it has been necessary to use data from several different sources and time periods and to determine reasonable estimates. No attempt is made here to infer current or future supply/demand relationships from these data; the intent is rather to illustrate the relative magnitudes of these flows (insofar as possible) from the historic data available.

Note that these flows are highly sensitive to S/E supply/demand conditions including such factors as economic growth; defense and R&D spending; the demographics, interest, and capabilities of the population which affect the number of new entrants to and attrition from stock; legislation and policy affecting the entry of foreign students and immigrants; and policies and laws regulating retirement ages; etc. The data presented in chart 46 illustrate the relative importance and mag-

Chart 46. Estimated changes in stock and flow of natural scientists, engineers and computer specialists 1985 to 1986



Notes: NS,E&CS=employed in natural science, engineering and computer specialist jobs.
Absolute numbers rounded to nearest 5,000.
SOURCE: National Science Foundation, SRS; table B-26.

nitudes of the stock and the various flows. For this analysis, the most recent available estimates of the various stocks and rates of inflows and outflows were used to approximate the dynamics of change in the overall stock of natural scientists, engineers, and computer specialists (NS,E,&CS) between 1985 and 1986.[45] Details as to the sources of data used are provided in notes at the end of this chapter.

The stock of employed natural scientists, engineers, and computer specialists in 1986 reflected (1) those who remained in NS,E&CS employment from the previous year (about 92 percent of the 1985 total); (2) outflows of workers who left NS,E,&CS employment (about 8 percent of the 1985 total) because they left the labor force, switched to non-NS,E,&CS occupations, became unemployed, died, or emigrated; and (3) inflows of persons reentering NS,E,&CS work, recent graduates taking NS,E,&CS jobs, technicians and other skilled workers upgraded to or obtaining NS,E,&CS positions, and foreign scientists and engineers. From 1985 to 1986, an estimated two-thirds of such inflows were needed to replace workers who left NS,E,&CS employment; the remaining one-third met the growth in NS,E,&CS jobs stemming from economic expansion, increased military expenditures, greater technological intensity, and additional R&D.

outflows from ns,e,&cs employment

The total estimated outflow during 1985 from the employed NS,E,&CS workforce was about 8 percent of those employed as natural scientists, engineers, and computer specialists at the beginning of the year. The remaining 92 percent of the NS,E,&CS workers remained in the NS,E,&CS workforce and comprised the bulk of that workforce the following year. Of the 8 percent of the workers who left NS,E,&CS employment, the largest outflow was of persons changing to non-NS,E,&CS occupations; these represented over two-fifths of total outflow. About one-third exited the labor force completely (e.g., retirees, those returning to school, those choosing to stay home to rear children, etc.). The remainder of the total outflow included aliens previously admitted to the United States and naturalized citizens who emigrated, those who became unemployed, and those who died.[46] Each of these groups (except, of course, the deceased) represents a possible source of reentrants to the NS,E,&CS workforce.

inflows to ns,e,&cs employment

Entrants are needed to fill the new NS,E,&CS jobs created by economic growth and the increasing demand for NS,E,&CS personnel. Replacements must also be found for the people who leave the workforce. About 260,000 of those employed as natural scientists, engineers, and computer specialists left the NS,E,&CS workforce from 1985 to 1986. Analysis of the 1986 stock shows that, besides the replacements needed for this outflow, an additional 140,000 people were hired to fill the approximately 5-percent increase in total NS,E,&CS jobs created from 1985 to 1986. Total estimated NS,E,&CS inflows (400,000) are equivalent to about 12 percent of the 1986 NS,E,&CS stock of 3.3 million.

New U.S. citizen NS,E,&CS graduates represented the largest component of total inflow to the 1986 stock: approximately 45 percent.[47] The second largest portion of the inflow (38 percent) consisted of scientists and engineers—who had been doing non-NS,E&CS work or who were temporarily out of the labor force—who reentered the NS,E,&CS workforce.[48] The recent foreign graduates of U.S. universities and colleges and direct immigration of experienced foreign scientists and engineers together made up about 10 percent of the inflow.[49] About 5 percent was accounted for by persons upgraded to engineering jobs.[50]

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[45] Comparable estimates for social and psychological scientists are shown on appendix table B-26. Data from the 1985 and 1986 Current Population Surveys and the 1986 Occupational Employment Statistics Survey (unpublished tabulations, U.S. Department of Labor, Bureau of Labor Statistics) were used to develop the estimates of the stock of persons employed in S/E occupations. For more information concerning these surveys, see Bulletin 2134-1, *BLS Handbook of Methods* (Washington, D.C.: Bureau of Labor Statistics, December 1982).

Note that 1986 data are presented elsewhere in this report on the characteristics of persons classified as scientists or engineers based on their education and experience. These data are not strictly comparable with the information in this section, which describes S/E occupational patterns.

[46] *Attrition* out of the labor force (except for death and emigration) was calculated by applying occupation-specific separation rates for the 1983-84 period. See U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Projections and Training Data, 1986 Edition* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1986), table C-1.

Annual transfer rates to non-NS,E&CS occupations were estimated from longitudinal survey data of scientists and engineers in the 1980 population by their occupational status in 1982 and 1984 from tabulations of unpublished NSF data prepared by Dr. Robert Dauffenbach, Oklahoma State University. The transfer rates do not include persons who transferred to manager/administrator jobs if these were related to the management or administration of NS,E&CS activities. The rates also do not apply to transfers among NS,E&CS fields, but only out of the NS,E&CS workforce.

Annual death rates by sex and age are from estimates for the population by the Bureau of the Census for the 1985-90 period applied to NSF distributions of scientists and engineers by age and sex. The "Low Mortality Assumption" table was used to account for differences in racial mix and type of employment between the general population and NS,E&CS workers. See U.S. Department of Commerce, Bureau of the Census, *Projections of the Population of the United States by Age, Sex, and Race: 1983 to 2080, Series P-25*, No. 952 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, May 1984), table B-1A.

Unemployment does not include the stock of unemployed in 1985, but only the net change in unemployment from 1985 to 1986. Unemployment rates are from occupation-specific data (U.S. Department of Labor, Bureau of Labor Statistics, unpublished). *Emigration rates* were estimated separately for naturalized U.S. citizens and aliens. The rates are from estimates of average emigration for the 1981-85 period. See Michael G. Finn and Sheldon B. Clark, "Estimating Emigration of Foreign-Born Scientists and Engineers in the United States," working paper (Oak Ridge, Tenn.: Oak Ridge Associated Universities, January 1988). The estimates for emigration assume that there is no net emigration of natural-born citizens. Data on alien NS,E&CS admissions are from the U.S. Immigration and Naturalization Service (unpublished).

[47] The estimates for new bachelor's- and master's-degree graduate entrants are from National Science Foundation, *Characteristics of Recent Science and Engineering Graduates: 1986*, Detailed Statistical Tables, NSF 87-321 (Washington, D.C., 1987). Estimates for new Ph.D. recipients are from National Science Foundation, *Science and Engineering Doctorates: 1960-86*, op. cit. The data for new bachelor's- and master's-degree recipients are for the 1986 labor force status of 1985 graduates who were not full-time graduate students in 1986; these data exclude foreign students who had a foreign address at the time of the survey. The labor force entrance rates for the 1985 graduates were adjusted upward based on the status of 1984 graduates in 1986. The longer post- graduation lag-time was used to provide a more realistic estimate of the contribution of recent graduates to the NS,E&CS workforce, as participation rates increase substantially between the first and second year after leaving school.

The data also were adjusted for an estimate of double counting of master's- and Ph.D.-degree recipients who may already have been employed in NS,E&CS jobs while in graduate school. Downward adjustments for Ph.D's were made for those reporting that their major source of support in graduate school was teaching or research assistantships, employer funds, or own earnings. The Ph.D. rates for employer funds and own earnings were applied to the master's new entrants since such data are not collected for them. All bachelor's new entrants were assumed to be first-time entrants.

The aforementioned surveys of new entrants do not include those receiving a bachelor's of technology degree. An estimate for bachelor's of technology degree recipients becoming NS,E,&CS workers was calculated by assuming the same labor force participation rates as engineering bachelor's-degree recipients and applying that rate to the 19,600 bachelor's of technology degrees awarded in 1985. The resulting 16,600 new entrants are included in the inflow to the NS,E,&CS workforce.

[48] This proportion is the remainder of the inflow requirements for growth and replacement after accounting for the inflows of new graduates, immigrants, and worker upgrad-

Note that the inflow of new NS,E,&CS graduates from 1985 to 1986 was greater than the increase in total NS,E,&CS jobs created during this period: 180,000 versus 140,000. The difference (40,000) was the amount by which total outflow from 1985 exceeded total inflow to the 1986 stock, excluding new graduates.

stock of possible ns,e,&cs reentrants

As noted above, almost 40 percent of the inflow to the 1986 NS,E&CS stock were reentrants to the employed NS,E,&CS workforce; included in this group would be natural science, engineering, and computer science graduates[51] who had delayed entering the labor force (although not strictly reentrants, they are included in this category); NS,E,&CS personnel who were employed in non-NS,E,&CS jobs in 1985; and other NS,E,&CS personnel who had not worked that year. This last group would include persons who may have retired from NS,E,&CS employment or who temporarily left the labor force for childrearing or other reasons.

There are substantial numbers of persons of working age with formal S/E training who are not employed in NS,E,&CS occupations. For example, in the 25 years between 1961 and 1986, 3.9 million bachelor's degrees in the natural sciences, engineering, and computer science were awarded in the United States. This was roughly 800,000 more than the number of persons employed in NS,E&CS occupations. However, the ability of this group to meet exigencies of possible future shortfalls in the supply of new entrants is not known. First, the willingness of its members to return to NS,E,&CS jobs would vary substantially depending upon the following factors: individual level of NS,E,&CS training and experience; their age; their attachment to their current employment or other labor force status; the length of time they have been away from NS,E,&CS work; and labor market conditions affecting employers' willingness to hire or retrain them or to pay sufficient wages to attract them from high-paying positions outside the NS,E,&CS workforce. Further, the ability to supply needed workers will be limited to the extent that the stock of potential NS,E,&CS re- entrants matches workforce requirements by occupation, skills, or experience. This group merits further study to determine its contribution to the NS,E,&CS workforce.

summary

The following summarizes the major points of this analysis of the stock and flow of natural scientists, engineers, and computer specialists between 1985 and 1986.

- Over the 1-year period studied, the stock was more than 10 times as large as the flow. Slightly more than 8 percent of the 1985 NS,E,&CS workforce left and just over 12 percent of the 1986 NS,E,&CS were new or reentrants.
- The most important factors in the estimated 1985 outflow are those moving to non-NS,E,&CS work (over two-fifths) and those leaving work (over one-third). The other factors—death, unemployment, emigration—each account for one-tenth or less of the outflow. Since total outflow is less than 9 percent of total stock, each of these latter three outflow factors represents approximately between 0.3 percent and 0.8 percent of the estimated 1985 stock.
- About two-thirds of NS,E,&CS inflows were used to replace outflows; the remaining one-third was applied to growth in NS,E,&CS employment. The key factors in the estimated inflows to the 1986 NS,E,&CS workforce are new U.S. citizen graduates (about 45 percent) and reentrants (about 40 percent). Each of the other factors—worker upgrades, immigration, and new foreign graduates—accounts for 7 percent or less of the inflow. Since total inflow is only about 13 percent of total stock, each of these latter three inflow sources represents between about 0.4 percent and 0.9 percent of the estimated 1986 stock.
- As shown by sensitivity testing, the acknowledged lack of statistical precision in the procedures used to estimate some of the minor factors in this section have relatively little effect on the results. If, for example, the estimate for worker upgrades (admittedly a difficult number to estimate given current data) is off by as much as ± 50 percent, the relative impact of this group on the 1986 stock would be between 0.4 percent and 1.1 percent—i.e., (25,000 ± 12,500)/3,275,000. Similarly, any other dubious minor factor would have minimal impact even if a range of ± 50 percent were used to test the effect of the estimating procedures.

The preceding examination of NS,E,&CS worker stock and flows clearly illustrates that—given both the high degree of stability of the NS,E,&CS employment stock and the demonstrated availability of multiple supply sources—substantial adjustments to changing supply and demand conditions in the NS,E,&CS labor market are possible. The relevant questions about such adjustments are what are their costs in terms of time, resources, etc.; would they be sufficient to meet a sustained increase in demand; and how the quality of NS,E,&CS personnel would be affected.

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[49] Estimates for foreigners receiving U.S. bachelor's and master's degrees are from flow rate estimates for 1981-82. See Michael G. Finn, *Foreign National Scientists and Engineers in the U.S. Labor Force, 1972-82* (Oak Ridge, Tenn.: Oak Ridge Associated Universities, June 1985). Data for foreigners with U.S. Ph.D.'s for 1985 are from National Science Foundation, *Science and Engineering Doctorates: 1960-86*, op. cit.

[50] In 1982, about 16 percent of employed engineering workers (171,000 persons) did not have a bachelor's degree. See National Science Foundation, *The 1982 Postcensal Survey of Scientists and Engineers*, NSF 84-330 (Washington, D.C., 1984). These persons are loosely designated as "upgraded workers." It is assumed that upgrading to engineer status for meritorious nondegreed persons from among the nearly 1 million engineering technicians and other persons with S/E training would continue at about the same rate to maintain their share of total engineering jobs.

[51] For this analysis, recent graduates who are full-time graduate students are not counted as part of the potential pool; estimates of their postschool outcomes are made after they leave school.

s/e supply/demand outlook

The size of the traditional 18- to 24-year-old college-age cohorts will decline through the early 1990s; furthermore, retirements may increase due to larger proportions of experienced S/E workers reaching 55 or older. This combination of forces suggests that the relatively smooth and rapid adjustments that have occurred in the past might no longer be counted on to entirely deal with increases in future demand. Not only will the flow of new entrants likely be smaller, but the stock of available people to help train them may be considerably diminished.[52] Many different market adjustment mechanisms will come into play to accommodate the decline in the traditional source of supply of new scientists and engineers. In the past, substantial occupational mobility[53] and increasing reliance on foreign- origin personnel (native-born U.S. citizens declined from 90 percent of the S/E labor force in 1972 to 83 percent in 1982)[54] have been largely responsible for the supply/demand equilibrium in the S/E labor market. Thus, some of the gap may be filled by increased enrollment of the 18- to 24-year cohort as well as older students and foreigners, many of whom remain to work in the United States. In addition, small shifts in the percentages of students electing to train in S/E fields and in the proportions of graduates who choose to enter S/E employment fields could provide an adequate supply of new entrants to the S/E workforce.[55]

What is uncertain is the magnitude of these possible adjustments. Past experience indicates that these supply movements, together with adjustments made by employers, have generally been sufficient to meet the growing demand for S/E personnel;[56] projecting ahead, however, is much more complex. For example, although it is known that women, ethnic minority, and older students are a rising proportion of all undergraduates, it is uncertain how many of them will enter S/E employment fields. Also, while it is believed that adjustments in enrollment patterns will be made in response to a growing demand for S/E graduates, it is not clear that any adjustments will be sufficient to provide an adequate supply in the future.

There are other possible adjustments. Labor force mobility is particularly important in instances of tight markets when newly trained S/E entrants and S/E personnel in the experienced pool may be induced to leave their current fields of specialization and transfer to higher demand fields. This is what occurred to satisfy the very high growth in demand for computer specialists. Also, fewer S/E-trained people may be attracted to non-S/E jobs. There may be delays in retirements of S/E workers in response to demand for their services; this has been a tactic used in forestalling past engineering shortages. Finally, employers may provide training and upgrading of technician personnel.

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[52] W. Lee Hansen, "The Impact of Demographic Trends on the Scientific and Engineering Work Force," testimony presented before the Science Policy Task Force, Committee on Science and Technology, U.S. House of Representatives, February 27, 1986).

[53] Robert C. Dauffenbach and Michael G. Finn, "Employer Provided Training and the Issue of Quality in the Engineering Work Force," prepared for National Science Foundation, Division of Science Resources Studies, STPSS, December 1984.

[54] National Science Foundation, *Young and Senior Science and Engineering Faculty and Nonfaculty Research Doctorates: 1986*, forthcoming.

[55] W. Lee Hansen, op.cit.

[56] For instance, a recent report from the National Research Council concluded that, since 1972, a substantial portion of job openings for engineers has been filled from pools other than the traditional supply source of new U.S. citizen engineering recipients. Consequently, the supply of engineering talent has been capable of adjusting to wide swings in employment. See Committee to Study Engineering Labor-Market Adjustments, *The Effects on Quality of Adjustments in Engineering Labor Markets* (Washington, D.C.: National Academy Press, 1988), pp. 37-38.

appendixes

a. technical notes
b. detailed statistical tables

appendix a

technical notes

concepts and definitions

NSF publishes a variety of data relating to scientists and engineers. These data—which include estimates of graduate enrollments and degree production as well as the number, work activities, sector of employment, and other economic and demographic characteristics of scientists and engineers—are developed by SRS as part of its ongoing programs. This appendix presents a brief examination of the major NSF data resources used in this report.

s/e personnel

Estimates of the characteristics of scientists and engineers in the United States were produced by NSF's Scientific and Technical Personnel Data System (STPDS). Broadly speaking, a person is considered a scientist or engineer if at least two of the following criteria are met:

(1) Degree in science (including social science) or engineering;
(2) Employed in an S/E occupation; and/or
(3) Professional identification as a scientist or engineer based on total education and experience.

national estimates

The STPDS is comprised of three subsystems, each designed to measure the characteristics of a particular subpopulation:

- **The Experienced Sample of Scientists and Engineers** is the biennial followup survey to the 1982 Postcensal Survey of Scientists and Engineers. The Postcensal Survey sample was drawn from those individuals who were in the S/E population at the time of the 1980 census. The Postcensal Survey and both the 1984 and 1986 Experienced Sample surveys were conducted for NSF by the Bureau of the Census. The 1986 survey, the most recent in this series, was based on a sample of 64,000 individuals.
- **The Survey of Recent Science and Engineering Graduates** is designed to measure the magnitude and characteristics of those who earned S/E degrees after the 1980 decennial census was completed. During the eighties, the Institute for Survey Research, Temple University, has conducted this survey series for NSF. The most recent survey, conducted in 1986, focused on the graduating classes of 1984 and 1985 and was based on a sample of 36,000 individuals.
- **The Survey of Doctorate Recipients** provides information on scientists and engineers granted doctorates in the United States over a 42-year period. The most recent survey, conducted in 1987, covered those individuals who received their doctorates between 1944 and 1986. The sample size for the 1987 survey was 65,200. Since 1973, this survey series has been conducted biennially for NSF by the Office of Scientific and Engineering Personnel, National Academy of Sciences.

In order to produce national estimates, data from the Experienced Sample and Recent Graduate surveys are integrated using a computer-based model. The Science and Engineering Tabulating Model, developed for NSF by Mathematica Policy Research, Inc., was used to generate national estimates for 1982, 1984, and 1986; it may also be employed as a projection model to generate preliminary estimates for future years (e.g., 1988).

selected variable definitions

Field of science and engineering. Data on field of employment are derived from responses to questions asking the name of the specialty most closely related to the respondent's principal employment. The specialty is chosen from a list provided in each questionnaire. Fields are classified as follows:

- **Physical science:** chemistry, physics, astronomy, and other physical sciences, including metallurgy
- **Mathematical science:** mathematics and statistics
- **Computer specialties**
- **Environmental science:** earth, atmospheric, and oceano- graphic sciences, including geophysics, seismology, and meteorology
- **Life science:** biological, agricultural, and medical sciences (excluding those engaged in patient care)
- **Psychology**
- **Social science:** economics, including agricultural economics; sociology; anthropology; and all other social sciences
- **Engineering:** aeronautical/astronautical, chemical, civil, electrical/electronics, materials science, mechanical, nuclear, petroleum, and other engineering

Data on field of employment are derived from responses to questions that request, based on employment specialties lists included with the questionnaire, the name of the specialty most closely related to the respondent's principal employment.

Work activities. Data on work activities of scientists and engineers represent their primary work activities. These data are derived from responses to survey questions that ask individuals to select, from a list of 10 to 15 choices, their primary and secondary work activities and to indicate the percentage of time devoted to these activities. Work activities are classified as follows:

- **Research and development (R&D):** basic research; applied research; development; and design of equipment, processes, and models
- **Management of R&D:** management or administration of R&D
- **General management:** management or administration of activities other than R&D
- **Teaching:** teaching and training
- **Production/inspection:** quality control, testing, evaluation, or inspection; and operations including production, maintenance, construction, installation, and exploration
- **Reporting, statistical work, and computing:** report and technical writing, editing, and information retrieval; statistical work including survey work, forecasting, and statistical analysis; computer applications

Additional work activities for which information is collected include distribution (sales, traffic, purchasing, customer and public relations), consulting, and other activities.

Sector of employment. Information on type of employer is also derived from individual survey respondents. Respondents are asked to choose the category which best describes the type of organization of their principal employment. Data on employment sector are classified as follows:

- **Industry:** business or industry as well as self-employed individuals
- **Educational institutions:** 4-year universities or colleges, medical schools, junior colleges, 2-year colleges, technical institutes, and elementary or secondary school systems
- **Federal Government:** civilian employment only

Other sectors of employment for which information has been collected include hospitals or clinics; nonprofit organizations, other than hospitals, clinics, or educational institutions; U.S. military service, active duty or Commissioned Corps; State and local governments; and other employers.

statistical measures

Labor force participation rate. The labor force is defined as those employed and those seeking employment. The labor force participation rate (RateL) is the ratio of those employed (E) and those unemployed (U) to the population (P).

S/E employment rate. The S/E employment rate (RateSE) measures the ratio of those holding jobs in science or engineering (SE) to the total employment (E) of scientists and engineers, which includes those holding nonscience or nonengineering jobs.

Unemployment rate. The unemployment rate (RateU) shows the ratio of those who are unemployed but seeking employment (U) to the total labor force (E + U).

S/E underemployment rate. The S/E underemployment rate (RateUE) shows the ratio of those who are working part time but seeking full-time jobs (PTS) or who are working in a non-S/E job when an S/E job would be preferred (NSE) to total employment (E).

S/E underutilization rate. The S/E underutilization rate (RateUZ) shows the proportion of those in the total labor force who are unemployed but seeking employment (U), working part time but seeking full-time jobs (PTS), or working in a non-S/E job when an S/E job would be preferred (NSE).

Reliability of s/e estimates. Estimates of scientists and engineers are derived from sample surveys and thus are subject to both sampling and nonsampling errors.

Sampling errors. The sample used for a particular survey is only one of many possible samples of the same size that could have been selected using the same sample design. Even if the same questionnaire and instructions were used, the estimates from each of the samples would differ. The deviation of the estimated sample from the average of all possible samples is defined as "sampling error." The standard error of a survey estimate attempts to provide a measure of this variation. Standard errors are thus indicators of the degree of precision with which a sample estimate approximates the average results for all possible samples.

The standard error may be used to construct a confidence interval about a given estimate. Thus, when the reported standard error is added to and subtracted from an estimate, the resulting range of values reflects an interval within which about 68 percent of all sample estimates, surveyed under the same conditions, will fall. Intervals reflecting a higher confidence level may be constructed by increasing the number of standard errors for a given estimate. Thus, ± 1.6 standard errors define a 90-percent confidence interval; ± 2.0 standard errors, a 95-percent confidence interval. The standard errors for the 1986 national data are estimated using the "Method of Random Groups."

Selected tables of standard errors for the various surveys are contained in the tables listed below:

Survey	Table
National estimates of total scientists and engineers	A-1
Doctoral scientists and engineers	A-2
Recent S/E graduates	A-3, A-4

The sampling errors shown here were generated based on approximations and must therefore be considered estimates rather than precise measurements.

Nonsampling errors. Nonsampling errors may be attributed to many sources: inability to obtain information about all cases; definitional difficulties; differences in the interpretation of questions; respondents' inability or unwillingness to provide correct information; mistakes in recording or coding the information; and other errors in collection, response, processing, coverage, and imputation.

Nonsampling errors are not unique to samples; they can occur in complete canvasses as well. No systematic attempt has been made to identify or approximate the magnitude of nonsampling errors associated with the estimates of scientists and engineers presented in this report.

earned degrees

bachelor's and master's degrees

Data on earned degrees in science and engineering at the bachelor's and master's levels are collected by the Center for Education Statistics of the U.S. Department of Education. These data cover earned degrees conferred in the aggregate United States, which includes the 50 States, the District of Columbia, and outlying areas. Degree data are compiled for the 12-month period from July through the following June.

doctorates

Data on doctorates granted in science and engineering are developed from the Survey of Earned Doctorates, conducted for NSF by the National Academy of Sciences. These data cover all types of doctoral degrees with the exception of such first-professional degrees as the J.D. or M.D. Data are collected for the aggregate United States and cover the period from July to the following June.

s/e occupations by industry

The 1980 and 1988 employment matrix of S/E occupations by industry sector discussed in chapter III were derived primarily from the Bureau of Labor Statistics' (BLS's) Occupational Employment Statistics (OES) survey of industrial employers. BLS has conducted the OES surveys annually since 1977, with support from NSF. The OES surveys are conducted in 3-year cycles: manufacturing industries are surveyed in the first year; mining, construction, financial, and various service industries in the second; and trade, communications, transportation, and public utilities in the third. Industry S/E staffing patterns for nonsurvey years are estimated by NSF utilizing patterns of relationships between S/E employment data from the OES and total employment data from BLS's Employment and Earnings. The OES survey data are combined with NSF estimates to produce annual S/E staffing patterns by industry sector so that year-to-year changes in the numbers of persons employed in S/E occupations may be approximated. These S/E job estimates for "private industry" exclude jobs in the agricultural, health, and educational services sectors. They also do not include jobs which primarily encompass management or administration functions or the self-employed, as the BLS surveys utilized in producing the occupational/industry matrix do not collect such data.

These data are not strictly comparable with the sectoral S/E employment data presented in chapter I, which are derived from the STPDS (described above).

projected s/e demand

The projections of a likely range of private industry requirements for scientists and engineers presented in this report were generated by the NSF's PC Occupations Modeling System (PCOCC). PCOCC was developed for NSF by Data Resources (DRI), a private firm which specializes in economic forecasting with an econometric model of the U.S. economy. Three projection scenarios were specified by NSF—a "low," a "high," and a "mid"—utilizing alternative sets of projected economic assumptions designed to encompass likely private sector performance during the simulation period of 1988-2000. PCOCC, which incorporates the DRI model, generates estimates of projected total employment by industry. The occupational structure applied to the total employment projections was developed by the BLS. For each industry, the BLS projected its occupational structure from 1986 to 2000 by analyzing factors that are expected to change the structure, such as changes in technology, business practices and methods of operation, and product demand.[1] These scenarios are not predictions, but rather show what might occur under the many assumptions discussed. Departures from these assumptions may alter future outcomes significantly. The scenarios were run in the summer of 1989.

Three estimates of future requirements were prepared—a low, a high, and a mid trend projection. The analysis in this report focuses on the mid trend. The major macroeconomic assumptions of the three scenarios are shown in table A-5.

In general, future economic trends which deviate from the assumptions of the mid scenario are not expected to be greater than those assumed in the high and low scenario projections.

Some of the key assumptions which especially affect the trendline—i.e., the mid scenario—for the industry projections are:

- A slowdown in labor force growth following the 1970s surge, during which the baby boom generation entered the workforce and labor force participation by women increased substantially;
- An average growth of 2.3 percent a year in real gross national product (GNP) between 1988 and 2000, and unemployment remaining between 5.4 percent and 5.8 percent throughout the projection period;
- Capital deepening and use of more efficient labor-management techniques will turn productivity around from its currently low levels of growth;
- Improvements in the Nation's international trade balance, with exports reaching 14.9 percent of GNP by 2000, compared with 8.9 percent in 1986 (the lowest figure since 1973) and 12.8 percent in 1980; and
- The decline in defense spending leveling by 1991, then resuming a modest increase after that.

Note: At the time of press, discussions within the Administration for continued reductions in the defense budget beyond 1991 were being reported. A preliminary analysis by NSF of the impact of the proposed additional budget cuts shows that demand for S/E personnel would increase at a slightly lower rate than that predicted under the mid-trend scenario.

data sources

Details on survey methods, coverage, concepts, definitions, and reliability of the data used in this report are contained in the following NSF publications:

U.S. Scientists and Engineers: 1986 (Detailed Statistical Tables) (NSF 87-322)

U.S. Scientists and Engineers: 1988 (Detailed Statistical Tables) (NSF 88-322)

Characteristics of Doctoral Scientists and Engineers in the United States: 1987 (Detailed Statistical Tables) (NSF 88-331)

Characteristics of Recent Science and Engineering Graduates: 1986 (Detailed Statistical Tables) (NSF 87-321)

A brief description of each survey and copies of the survey instruments may be found in A Guide to NSF Science Resources Data. The Guide is available from the Office of the Division Director, Division of Science Resources Studies, 1800 G Street N.W., Room L-602, National Science Foundation, Washington, D.C. 20550.

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[1] See G.T. Silvestri and J.M. Lukasiewicz, "A Look at Occupational Employment Trends to the Year 2000," *Monthly Labor Review*, September 1987, pp. 46-63; and Ronald E. Kutcher, "Overview and Implication of the Projections to 2000," *Monthly Labor Review*, September 1987, pp. 47 and 48.

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Table A-1. Standard errors for estimates of total scientists and engineers: 1986

Size of estimate	Physical scientists: Chemists	Physical scientists: Physicists/ astronomers	Physical scientists: Other physical scientists	Mathematical scientists: Mathe- maticians	Mathematical scientists: Statis- ticians	Mathematical scientists: Computer specialists	Environmental scientists: Earth scientists	Environmental scientists: Ocean- ographers	Environmental scientists: Atmospheric scientists
100	250	110	50	180	50	560	130	40	30
200	260	130	80	200	70	570	140	80	50
500	290	180	150	260	140	590	170	190	130
700	310	210	200	290	180	610	190	260	180
1,000	340	250	270	350	230	630	220	370	250
2,500	480	480	600	600	450	750	370	730	570
5,000	720	830	1,000	990	650	940	600		980
10,000	1,200	1,400	1,600	1,600	880	1,300	970		1,400
25,000	2,300	2,400	2,500	2,300		2,300	1,600		
50,000	3,600	3,000		2,100		3,600	1,800		
75,000	4,400	4,800		3,500		4,600	2,400		
80,000	4,500	5,500		4,400		4,700	2,700		
100,000	5,000					5,200			
125,000	5,600					5,600			
150,000	6,500					5,800			
175,000	7,900					5,900			
200,000						6,000			
225,000						6,000			
250,000						6,200			
275,000						6,400			
300,000						6,900			
400,000									
500,000									

Table A-1. (cont.)

Size of estimate	Life scientists: Biologists	Life scientists: Agricultural scientists	Life scientists: Medical scientists	Psychologists	Social scientists: Economists	Social scientists: Sociogists/ anthro- pologists	Social scientists: Other social scientists	Engineers: Chemical engineers	Engineers: Aeronautical/ astronautical engineers
100	350	180	60	440	300	170	340	150	110
200	360	190	90	450	320	190	360	160	120
500	390	230	190	490	360	260	400	190	160
700	410	260	250	520	390	310	440	210	180
1,000	440	290	330	550	440	370	480	250	220
2,500	590	470	730	740	650	690	710	410	380
5,000	830	750	1,200	1,000	990	1,200	1,100	660	630
10,000	1,300	1,200	1,800	1,500	1,600	1,900	1,700	1,100	1,100
25,000	2,300	2,000	2,500	2,600	2,900	3,000	2,900	2,300	1,900
50,000	3,400	2,300		3,400	3,900	4,400	3,500	3,400	2,200
75,000	3,800	3,200		3,500	4,000	10,800	3,300	3,900	2,300
80,000	3,800	3,600		3,500	4,000	13,300	3,200	3,900	2,400
100,000	3,900			3,700	4,100		3,400	4,200	3,200
125,000	4,100			4,700	4,900		5,000	4,900	
150,000	4,800			7,400	7,300			6,200	
175,000	6,200			12,400					
200,000	8,800			20,500					
225,000									
250,000									
275,000									
300,000									
400,000									
500,000									

Table A-1. (cont.)

	Engineers								
Size of estimate	Civil engineers	Electrical/ electronics engineers	Mechanical engineers	Materials engineers	Mining engineers	Nuclear engineers	Petroleum engineers	Industrial engineers	Other engineers
100	160	300	220	50	30	40	50	120	330
200	170	300	230	60	60	70	80	130	340
500	190	320	240	110	130	140	150	170	360
700	200	330	260	150	170	190	190	200	370
1,000	220	340	270	190	240	270	250	230	390
2,500	320	410	360	420	530	570	540	420	480
5,000	480	540	510	760	870	890	890	720	620
10,000	790	770	800	1,300	1,200	1,100	1,200	1,300	910
25,000	1,600	1,500	1,600	2,000			1,600	2,600	1,700
50,000	2,700	2,500	2,800	2,300				3,900	2,800
75,000	3,600	3,300	3,800					4,600	3,700
80,000	3,700	3,500	4,000					4,700	3,900
100,000	4,100	4,000	4,600					5,300	4,500
125,000	4,400	4,700	5,300					6,600	5,000
150,000	4,600	5,200	5,900						5,400
175,000	4,700	5,600	6,300						5,700
200,000	4,600	5,900	6,600						5,900
225,000	4,500	6,200	6,900						6,000
250,000	4,500	6,500	7,200						6,100
275,000	4,500	6,700	7,400						6,200
300,000	4,500	6,900	7,500						6,300
400,000		7,900	8,600						7,300
500,000		9,800	11,000						10,600

SOURCE: Mathematica Policy Research, Inc.

Table A-2. Approximate standard errors for estimated percents of doctoral scientists and engineers by field: 1987 Survey of Doctorate Recipients

Base number of percent	Estimated Percent						
	1/99	2/98	5/95	10/90	15/85	25/75	50
50	6.2	8.8	13.6	18.8	22.3	27.1	31.3
100	4.4	6.2	9.6	13.3	15.8	19.1	22.1
200	3.1	4.4	6.8	9.4	11.2	13.5	15.6
500	2.0	2.8	4.3	5.9	7.1	8.6	9.9
700	1.7	2.3	3.6	5.0	6.0	7.2	8.4
1,000	1.4	2.0	3.0	4.2	5.0	6.1	7.0
2,500	0.9	1.2	1.9	2.7	3.2	3.8	4.4
5,000	0.6	0.9	1.4	1.9	2.2	2.7	3.1
10,000	0.4	0.6	1.0	1.3	1.6	1.9	2.2
25,000	0.3	0.4	0.6	0.8	1.0	1.2	1.4
50,000	0.2	0.3	0.4	0.6	0.7	0.9	1.0
75,000	0.2	0.2	0.4	0.5	0.6	0.7	0.8
100,000	0.1	0.2	0.3	0.4	0.5	0.6	0.7
150,000	0.1	0.2	0.2	0.3	0.4	0.5	0.6
200,000	0.1	0.1	0.2	0.3	0.4	0.4	0.5
250,000	0.1	0.1	0.2	0.3	0.3	0.4	0.4
300,000	0.1	0.1	0.2	0.2	0.3	0.3	0.4
400,000	0.1	0.1	0.2	0.2	0.2	0.3	0.3

Approximate standard errors for estimated percents of women doctoral scientists and engineers by field: 1987 Survey of Doctorate Recipients

Base number of percent	Estimated Percent						
	1/99	2/98	5/95	10/90	15/85	25/75	50
50	4.1	5.8	9.0	12.4	14.8	17.9	20.7
100	2.9	4.1	6.4	8.8	10.4	12.6	14.6
200	2.1	2.9	4.5	6.2	7.4	8.9	10.3
500	1.3	1.8	2.8	3.9	4.7	5.7	6.5
700	1.1	1.5	2.4	3.3	3.9	4.8	5.5
1,000	0.9	1.3	2.0	2.8	3.3	4.0	4.6
2,500	0.6	0.8	1.3	1.8	2.1	2.5	2.9
5,000	0.4	0.6	0.9	1.2	1.5	1.8	2.1
10,000	0.3	0.4	0.6	0.9	1.0	1.3	1.5
25,000	0.2	0.3	0.4	0.6	0.7	0.8	0.9
50,000	0.1	0.2	0.3	0.4	0.5	0.6	0.7

SOURCE: National Research Council

Table A-3. Generalized standard errors for recent science/engineering degree recipients by field: 1986 New Entrants Survey
Bachelor's Recipients

Estimate	Total science and engineering	Physical sciences				Math-ematics/ statistics	Com-puter sciences	Environ-mental sciences	Life sciences			Psy-chology	Social sciences			
		Total	Chemis-try	Physics/ astronomy	Other physical sciences				Total	Biology	Agricultural sciences		Total	Economics	Sociology/ anthropl-ogy	Other social sciences
25	73	49	44	40	49	45	52	36	62	64	40	67	95	95	90	102
50	103	69	62	56	69	84	74	50	87	90	56	95	134	134	126	144
75	126	84	76	68	84	78	90	61	107	110	68	116	164	164	154	176
100	145	97	87	79	97	90	104	70	123	127	79	134	189	190	178	203
200	205	136	123	110	134	127	147	98	173	178	111	189	267	267	251	286
300	251	166	149	133	161	155	179	120	212	218	135	231	327	327	306	350
400	290	191	172	151	183	178	207	137	245	252	155	266	377	377	352	404
500	324	213	191	167	200	198	231	152	273	281	172	297	422	420	392	451
750	396	259	231	198	233	241	281	183	333	343	208	362	515	512	477	550
1,000	457	297	263	221	253	276	324	207	384	394	238	416	594	588	546	633
1,500	560	358	313	250	268	332	394	244	468	479	284	506	725	714	657	770
2,000	645	406	350	263	253	377	452	269	537	549	319	579	835	816	745	883
2,500	721	447	380	263	199	414	502	287	597	609	347	643	930	903	817	980
3,000	789	481	402	249		446	546	299	650	662	369	698	1,016	979	878	1,066
4,000	910	535	430	164		495	622	304	742	753	400	793	1,165	1,106	973	1,213
5,000	1,016	575	441			531	685	288	820	829	415	872	1,294	1,209	1,040	1,337
6,000	1,111	603	433			556	740	244	888	893	417	938	1,408	1,294	1,085	1,442
7,000	1,198	621	408			572	787	154	947	948	406	995	1,511	1,364	1,110	1,533
8,000	1,278	630	361			578	829		1,000	996	380	1,044	1,604	1,421	1,116	1,612
9,000	1,354	630	281			577	865		1,047	1,037	337	1,085	1,690	1,466	1,104	1,682
10,000	1,425	621	113			566	897		1,089	1,073	268	1,121	1,769	1,502	1,073	1,742
15,000	1,731	410				341	1,003		1,241	1,181		1,221	2,088	1,542	459	1,935
20,000	1,983						1,036		1,317	1,190		1,209	2,318	1,354		1,980
25,000	2,198						1,003		1,331	1,103		1,081	2,483	787		1,886
30,000	2,388						897		1,284	893		783	2,595			1,629
40,000	2,710								964				2,685			
50,000	2,976												2,608			
60,000	3,201												2,347			
70,000	3,391												1,826			
80,000	3,554												524			
90,000	3,692															
100,000	3,808															
150,000	4,114															
200,000	4,016															
230,000	3,756															
250,000	3,481															
300,000	2,210															

Table A-3 (cont.)

Estimate	Engineering											
	Total	Aeronautical/ astronautical	Chemical	Civil	Electrical/ electronics	Industrial	Materials	Mechanical	Mining	Nuclear	Petroleum	Other
25	86	36	24	28	38	39	20	38	23	14	23	40
50	51	51	34	40	54	54	27	53	33	19	32	57
75	62	61	41	49	66	66	33	65	39	22	39	69
100	72	71	48	56	76	76	38	75	45	25	45	80
200	101	98	67	78	106	106	51	105	60	31	61	112
300	124	117	81	96	130	129	59	128	70	31	72	137
400	143	132	93	110	150	147	65	148	76	26	79	157
500	159	144	103	122	167	163	68	165	79		85	175
750	195	166	123	147	203	195	69	200	77		91	211
1,000	224	179	140	168	234	219	59	229	58		87	240
1,500	274	183	163	199	283	254		277			35	287
2,000	315	159	180	223	324	275		315				322
2,500	351	86	190	242	358	285		346				349
3,000	384		196	256	389	287		373				371
4,000	440		195	273	439	262		417				399
5,000	489		177	279	480	186		450				411
6,000	533		133	274	514			474				409
7,000	571			256	541			491				391
8,000	607			224	564			502				356
9,000	640			168	582			506				298
10,000	670			19	596			505				198
15,000	792				613			397				
20,000	881				539							
25,000	946				316							
30,000	992											
40,000	1,036											
50,000	1,020											
60,000	943											
70,000	786											
80,000	476											
90,000												
100,000												
150,000												
200,000												
230,000												
250,000												
300,000												

SOURCE: Institute for Survey Research, Temple University

Table A-4. Generalized standard errors for recent science/engineering degree recipients by field:
1986 New Entrants Survey-Con.
Master's Recipients

Estimate	Total science and engineering	Physical sciences				Mathematics/ statistics	Computer sciences	Environmental sciences	Life sciences			Psychology	Social sciences			
		Total	Chemistry	Physics/ astronomy	Other physical sciences				Total	Biology	Agricultural sciences		Total	Economics	Sociology/ anthropology	Other social sciences
25	36	26	25	22	25	29	33	28	31	34	19	42	46	45	49	45
50	50	36	35	30	35	41	47	39	44	48	27	58	64	62	68	64
75	61	44	42	37	42	50	57	48	54	58	32	71	79	76	83	78
100	71	51	48	42	47	58	66	55	62	67	37	82	91	87	95	89
200	100	71	66	57	60	80	92	76	87	94	51	114	127	121	132	125
300	122	86	78	67	64	97	112	91	105	114	61	137	155	144	158	151
400	141	98	87	74	62	110	129	103	121	130	69	156	178	163	178	173
500	157	108	94	80	52	121	143	113	134	144	76	171	198	178	194	191
750	192	127	104	86		142	173	130	161	172	87	200	239	204	222	226
1,000	221	141	104	83		157	197	140	183	193	93	220	272	218	237	253
1,500	270	157	78	39		175	234	144	216	223	94	239	323	219	237	288
2,000	310	162				179	262	126	239	241	79	237	361	181	194	305
2,500	345	157				170	283	75	256	250	31	212	391	45		307
3,000	376	141				146	299		267	251		153	413			295
4,000	430	13					319		276	227			440			217
5,000	477						324		266	156			446			
6,000	518						315		237				434			
7,000	554						291		178				400			
8,000	587						247						341			
9,000	617						169						232			
10,000	644															
15,000	749															
20,000	816															
25,000	855															
30,000	870															
40,000	827															
50,000	671															
60,000	232															

Table A-4 (cont.)

Estimate	Engineering											
	Total	Aeronautical/ astronautical	Chemical	Civil	Electrical/ electronics	Industrial	Materials	Mechanical	Mining	Nuclear	Petroleum	Other
25	25	32	18	24	32	31	15	23	16	13	11	27
50	35	44	25	33	44	44	21	33	22	17	15	38
75	42	53	31	41	54	53	25	40	25	20	17	47
100	49	61	35	47	62	60	28	46	27	22	18	54
200	69	79	48	64	87	80	36	63	26	24	11	74
300	84	88	56	77	105	91	41	76		17		89
400	96	91	62	87	121	97	42	87				102
500	107	88	67	95	134	99	41	95				111
750	130	42	71	110	160	85	21	111				130
1,000	150		69	119	180			122				143
1,500	181		27	123	209			131				154
2,000	206			111	227			128				151
2,500	227			73	237			111				131
3,000	245				240			71				85
4,000	274				225							
5,000	296				175							
6,000	314											
7,000	326											
8,000	335											
9,000	340											
10,000	342											
15,000	295											
20,000												
25,000												
30,000												
40,000												
50,000												
60,000												

SOURCE: Institute for Survey Research, Temple University

Table A-5. Summary statistics for macroeconomic scenarios: 1988-2000

Indicators	Macroeconomic scenarios Low	 Mid	 High
	Average annual real growth (Percent)		
GNP	1.8	2.3	2.8
Consumption	1.5	1.9	2.4
Business fixed investment	2.6	3.5	4.5
Exports	4.8	5.7	6.4
Imports	3.0	3.6	4.3
	Average annual growth (Percent)		
Labor force	0.7	1.2	1.6
Productivity	1.3	1.4	1.6
Industrial production	2.2	2.9	3.5
	Average level (Percent)		
Inflation (GNP deflator)	6.2	5.0	4.2
Unemployment	5.9	5.6	5.4

Notes: Growth rates for the projection period are compound annual growth rates calculated between the years 1988 and 2000. Level variables are averages for the years 1989 to 2000.

SOURCES: National Science Foundation, SRS and Data Resources (DRI)

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Table B-1. Total employed scientists and engineers by field and gender: 1976-88

Field and gender	1976	1978	1980	1982	1984	1986	1988 1/
Total scientists and engineers.....	2,331,200	2,609,800	2,860,400	3,253,100	3,995,500	4,626,500	5,286,400
Men............................	2,131,600	2,367,600	2,544,800	2,864,100	3,482,900	3,927,800	4,417,400
Women..........................	199,700	242,200	315,600	388,900	512,600	698,600	867,900
Total scientists.................	959,500	1,071,000	1,184,500	1,405,700	1,781,400	2,186,300	2,567,800
Men............................	781,300	857,600	918,000	1,075,100	1,343,300	1,586,700	1,821,500
Women..........................	178,200	213,400	266,500	330,600	438,100	599,600	745,700
Physical scientists..............	188,900	208,300	215,200	227,400	254,100	288,400	312,000
Men..........................	172,700	189,800	194,500	205,100	225,800	250,100	265,500
Women........................	16,200	18,500	20,800	22,300	28,300	38,300	46,500
Mathematical scientists..........	48,600	53,700	64,300	79,400	100,400	131,000	168,600
Men..........................	37,100	40,500	46,400	54,000	78,500	97,100	123,600
Women........................	11,500	13,100	18,000	25,300	21,900	33,900	44,900
Computer specialists.............	119,000	177,000	207,800	299,000	436,800	562,600	708,300
Men..........................	98,400	136,800	149,900	220,300	322,700	400,000	489,300
Women........................	20,600	40,200	57,900	78,700	114,100	162,500	218,700
Environmental scientists.........	54,800	68,900	77,600	87,200	98,100	111,300	113,400
Men..........................	50,900	61,700	66,800	74,800	87,800	98,400	101,000
Women........................	3,900	7,200	10,700	12,400	10,300	12,900	12,300
Life scientists..................	213,500	244,100	287,500	337,100	353,300	411,800	458,600
Men..........................	179,600	204,500	234,400	268,500	270,700	309,000	330,800
Women........................	33,900	39,600	53,100	68,600	82,600	102,800	127,700
Psychologists....................	112,500	121,700	128,100	138,400	209,500	253,500	275,900
Men..........................	76,900	79,700	79,400	83,000	121,100	138,400	143,900
Women........................	35,600	42,000	48,700	55,400	88,400	115,200	132,000
Social scientists................	222,300	197,400	204,000	237,200	329,200	427,800	531,000
Men..........................	165,700	144,600	146,700	169,300	236,800	293,800	367,300
Women........................	56,600	52,800	57,200	67,900	92,400	134,000	163,700
Total engineers..................	1,371,700	1,538,800	1,675,900	1,847,200	2,214,100	2,440,100	2,718,600
Men..........................	1,350,300	1,510,000	1,626,700	1,789,000	2,139,600	2,341,100	2,596,000
Women........................	21,400	28,800	49,200	58,300	74,500	99,000	122,200
Astronautical/aeronautical.......	56,800	62,000	69,500	80,800	97,200	110,500	119,400
Men..........................	56,400	61,400	68,300	78,700	94,900	106,200	114,200
Women........................	400	600	1,200	2,100	2,200	4,300	5,300
Chemical.........................	77,500	84,200	94,500	107,700	140,100	149,000	148,500
Men..........................	75,000	81,700	90,000	101,600	131,300	137,800	136,000
Women........................	2,500	2,500	4,500	6,100	8,800	11,200	12,500
Civil............................	188,200	211,700	232,100	258,200	312,700	346,300	355,900
Men..........................	182,800	208,400	226,300	252,200	303,400	333,400	346,600
Women........................	5,400	3,300	5,800	6,100	9,300	12,900	9,300
Electrical/electronics...........	283,000	341,500	383,100	437,700	500,700	574,500	640,900
Men..........................	281,400	338,000	375,400	428,600	488,500	555,500	616,900
Women........................	1,600	3,500	7,600	9,100	12,200	18,900	23,800
Mechanical.......................	276,200	299,300	322,600	357,900	445,600	492,600	497,800
Men..........................	273,900	295,200	316,000	350,800	434,600	478,600	480,900
Women........................	2,300	4,100	6,600	7,100	11,000	14,000	16,900
Other engineers..................	490,000	540,100	574,100	604,900	717,800	767,200	956,100
Men..........................	480,900	525,400	550,600	577,100	686,900	729,600	901,400
Women........................	9,100	14,700	23,500	27,800	31,000	37,700	54,400

1/ 1988 data are model generated rather than survey generated estimates and therefore trends (especially short term) should be treated with caution.

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-2. Scientists and engineers employed in science/engineering jobs by field and gender: 1976-86

Field and gender	1976	1978	1980	1982	1984	1986
Total scientists and engineers....	2,122,100	2,364,400	2,542,700	2,866,700	3,465,100	3,919,900
Men............................	1,947,200	2,153,000	2,269,900	2,552,500	3,070,400	3,393,700
Women..........................	174,900	211,300	272,800	314,200	394,600	526,200
Total scientists..................	843,800	937,500	1,032,800	1,147,500	1,402,900	1,676,400
Men............................	689,100	753,800	806,200	887,700	1,078,200	1,242,800
Women..........................	154,700	183,700	226,600	259,900	324,700	433,600
Physical scientists.............	154,900	168,200	166,300	210,500	234,000	264,900
Men..........................	143,600	155,700	151,700	190,000	208,000	229,500
Women........................	11,300	12,500	14,500	20,500	26,000	35,400
Mathematical scientists.........	43,800	48,000	57,300	68,300	87,000	103,900
Men..........................	33,700	36,700	42,100	45,500	68,200	78,900
Women........................	10,000	11,400	15,200	22,800	18,800	25,000
Computer specialists............	116,000	171,400	196,700	216,100	340,400	437,200
Men..........................	95,400	131,300	147,600	158,700	251,600	308,700
Women........................	20,600	40,000	49,100	57,400	88,800	128,400
Environmental scientists........	46,600	56,900	63,100	82,700	89,900	97,300
Men..........................	44,000	51,600	54,700	71,100	80,800	87,200
Women........................	2,600	5,300	8,400	11,700	9,100	10,100
Life scientists.................	198,200	227,800	267,300	298,000	294,100	340,500
Men..........................	167,700	191,800	218,400	239,000	226,000	257,100
Women........................	30,500	36,000	48,900	59,000	68,100	83,300
Psychologists...................	103,700	107,400	112,500	105,600	151,900	172,800
Men..........................	71,600	71,100	70,400	66,400	92,900	99,500
Women........................	32,000	36,300	42,100	39,300	59,000	73,300
Social scientists...............	180,500	157,800	169,700	166,200	205,600	259,800
Men..........................	133,200	115,700	121,300	117,000	150,800	181,800
Women........................	47,300	42,200	48,300	49,200	54,900	78,000
Total engineers...................	1,278,300	1,426,900	1,509,900	1,719,100	2,062,200	2,243,500
Men..........................	1,258,100	1,399,300	1,463,600	1,664,800	1,992,200	2,150,900
Women........................	20,200	27,700	46,200	54,300	70,000	92,600
Astronautical/aeronautical......	55,700	61,100	65,000	77,200	91,800	104,200
Men..........................	55,300	60,500	63,800	75,100	89,600	100,300
Women........................	400	600	1,200	2,100	2,200	3,900
Chemical........................	76,400	81,900	89,000	101,100	127,500	131,500
Men..........................	74,100	79,400	84,500	95,300	119,200	121,200
Women........................	2,500	2,500	4,500	5,700	8,300	10,300
Civil...........................	182,800	205,200	217,000	243,700	293,000	319,100
Men..........................	178,100	201,900	211,500	237,900	284,400	307,200
Women........................	4,800	3,300	5,500	5,900	8,500	11,900
Electrical/electronics..........	267,900	327,000	357,400	413,500	475,000	540,800
Men..........................	266,500	323,600	350,200	405,400	463,800	523,200
Women........................	1,400	3,500	7,200	8,100	11,200	17,600
Mechanical......................	272,800	296,500	308,800	334,400	414,000	453,700
Men..........................	270,600	292,300	302,200	327,700	403,300	440,100
Women........................	2,200	4,200	6,600	6,700	10,700	13,600
Other engineers.................	422,700	455,200	472,700	549,200	660,900	694,200
Men..........................	413,500	441,600	451,400	523,400	631,900	658,900
Women........................	8,900	13,600	21,200	25,800	29,100	35,300

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-3. Scientists and engineers employed in nonscience/engineering jobs, by field and gender: 1976-86

Field and gender	1976	1978	1980	1982	1984	1986
Total scientists and engineers	209,100	245,400	317,700	386,400	530,400	706,600
Men	184,400	214,600	274,900	311,600	412,500	534,100
Women	24,800	30,900	42,800	74,700	118,000	172,400
Total scientists	115,700	133,500	151,700	258,200	378,500	509,900
Men	92,200	103,900	111,800	187,400	265,100	343,900
Women	23,500	29,800	39,900	70,700	113,400	166,000
Physical scientists	34,000	40,100	48,900	16,900	20,100	23,500
Men	29,100	34,100	42,800	15,100	17,800	20,600
Women	4,900	6,000	6,300	1,800	2,300	2,900
Mathematical scientists	4,800	5,700	7,000	11,100	13,400	27,100
Men	3,400	3,800	4,300	8,500	10,300	18,200
Women	1,500	1,700	2,800	2,500	3,100	8,900
Computer specialists	3,000	5,600	11,100	82,900	96,400	125,400
Men	3,000	5,500	2,300	61,600	71,100	91,300
Women	0	200	8,800	21,300	25,300	34,100
Environmental scientists	8,200	12,000	14,500	4,500	8,200	14,000
Men	6,900	10,100	12,100	3,700	7,000	11,200
Women	1,300	1,900	2,300	700	1,200	2,800
Life scientists	15,300	16,300	20,200	39,100	59,200	71,300
Men	11,900	12,700	16,000	29,500	44,700	51,900
Women	3,400	3,600	4,200	9,600	14,500	19,500
Psychologists	8,800	14,300	15,600	32,800	57,600	80,700
Men	5,300	8,600	9,000	16,600	28,200	38,900
Women	3,600	5,700	6,600	16,100	29,400	41,900
Social scientists	41,800	39,600	34,300	71,000	123,600	168,000
Men	32,500	28,900	25,400	52,300	86,000	112,000
Women	9,300	10,600	8,900	18,700	37,500	56,000
Total engineers	93,400	111,900	166,000	128,100	151,900	196,600
Men	92,200	110,700	163,100	124,200	147,400	190,200
Women	1,200	1,100	3,000	4,000	4,500	6,400
Astronautical/aeronautical	1,100	900	4,500	3,600	5,400	6,300
Men	1,100	900	4,500	3,600	5,300	5,900
Women	0	0	0	0	0	400
Chemical	1,100	2,300	5,500	6,600	12,600	17,500
Men	900	2,300	5,500	6,300	12,100	16,600
Women	0	0	0	400	500	900
Civil	5,400	6,500	15,100	14,500	19,700	27,200
Men	4,700	6,500	14,800	14,300	19,000	26,200
Women	600	0	300	200	800	1,000
Electrical/electronics	15,100	14,500	25,700	24,200	25,700	33,700
Men	14,900	14,400	25,200	23,200	24,700	32,300
Women	200	0	400	1,000	1,000	1,300
Mechanical	3,400	2,800	13,800	23,500	31,600	38,900
Men	3,300	2,900	13,800	23,100	31,300	38,500
Women	100	0	0	400	300	400
Other engineers	67,300	84,900	101,400	55,700	56,900	73,000
Men	67,400	83,800	99,200	53,700	55,000	70,700
Women	200	1,100	2,300	2,000	1,900	2,400

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-4. Employed doctoral scientists and engineers by field and gender: 1977-87

Field and gender	1977	1979	1981	1983	1985	1987
Total scientists and engineers	285,055	314,257	343,956	369,320	400,358	419,118
Men	257,465	280,857	302,971	320,494	341,873	352,386
Women	27,590	33,400	40,985	48,826	58,485	66,732
Total scientists	240,005	263,915	286,917	307,775	334,505	351,350
Men	212,696	231,040	246,685	260,025	277,508	286,346
Women	27,309	32,875	40,232	47,750	56,997	65,004
Physical scientists	57,531	60,222	63,110	63,986	67,480	68,647
Men	54,594	57,086	59,346	59,811	62,809	63,163
Women	2,937	3,136	3,764	4,175	4,671	5,484
Mathematical scientists	14,609	15,250	15,569	16,379	16,758	16,699
Men	13,560	14,104	14,259	14,964	15,199	15,074
Women	1,049	1,146	1,310	1,415	1,559	1,625
Computer specialists	5,767	6,684	9,064	12,164	14,964	18,571
Men	5,534	6,318	8,363	10,898	13,345	16,693
Women	233	366	701	1,266	1,619	1,878
Environmental scientists	13,001	14,575	15,909	16,467	17,288	17,811
Men	12,560	13,968	15,054	15,553	16,199	16,510
Women	441	607	855	914	1,089	1,301
Life scientists	70,537	78,857	84,912	92,802	101,838	107,378
Men	61,437	67,528	71,593	76,573	82,146	85,269
Women	9,100	11,329	13,319	16,229	19,692	22,109
Psychologists	33,652	37,848	42,829	46,645	52,182	56,378
Men	26,055	28,690	31,103	32,962	35,573	37,274
Women	7,597	9,158	11,726	13,683	16,609	19,104
Social scientists	44,908	50,479	55,524	59,332	63,995	65,866
Men	38,956	43,346	46,967	49,264	52,237	52,363
Women	5,952	7,133	8,557	10,068	11,758	13,503
Total engineers	45,050	50,342	57,039	61,545	65,853	67,768
Men	44,769	49,817	56,286	60,469	64,365	66,040
Women	281	525	753	1,076	1,488	1,728
Astronautical/aeronautical	1,987	2,364	2,519	3,684	3,827	5,005
Men	1,967	2,340	2,480	3,614	3,732	4,884
Women	20	24	39	70	95	121
Chemical	5,603	6,166	7,146	6,992	7,122	6,923
Men	5,575	6,117	7,092	6,895	7,021	6,783
Women	28	49	54	97	101	140
Civil	4,066	5,157	6,089	5,317	6,396	6,479
Men	4,051	5,101	6,003	5,245	6,305	6,316
Women	15	56	86	72	91	163
Electrical/electronics	8,284	8,597	10,630	12,696	14,248	12,601
Men	8,246	8,528	10,493	12,460	13,901	12,236
Women	38	69	137	236	347	365
Mechanical	4,648	5,245	5,370	5,657	6,594	6,711
Men	4,629	5,213	5,330	5,603	6,536	6,613
Women	19	32	40	54	58	98
Other engineers	20,462	22,813	25,285	27,199	27,666	30,049
Men	20,301	22,518	24,888	26,652	26,870	29,208
Women	161	295	397	547	796	841

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-5. Primary work activity for scientists and engineers employed in science/engineering jobs by field: 1976-86

Field and primary work activity	1976	1978	1980	1982	1984	1986
Total scientists and engineers	2,122,100	2,364,400	2,542,700	2,866,600	3,465,100	3,919,900
Research	209,000	230,800	262,700	314,300	340,900	376,000
Basic research	65,300	72,200	87,100	103,000	119,300	129,100
Applied research	143,700	158,600	175,600	211,300	221,600	246,900
Development	430,200	486,400	550,200	655,300	758,300	846,900
Management of R&D	212,700	242,100	237,600	253,600	335,500	371,700
Management other than R&D	386,600	416,700	421,100	448,800	583,100	628,400
Teaching	152,200	161,600	173,500	211,000	286,000	336,600
Production/inspection	223,200	285,100	319,600	380,000	477,200	512,800
Statistical work/computing	101,100	176,700	212,100	235,400	305,500	384,500
Total scientists	843,800	937,500	1,032,800	1,147,500	1,402,900	1,676,400
Research	159,300	178,600	202,100	241,800	251,600	277,400
Basic research	59,700	67,300	80,000	94,600	108,700	116,900
Applied research	99,600	111,300	122,100	147,200	142,900	160,500
Development	61,300	79,800	88,600	110,200	131,200	166,100
Management of R&D	83,800	92,000	92,900	96,400	121,800	144,400
Management other than R&D	130,100	142,200	149,500	139,000	179,800	209,600
Teaching	131,500	139,600	150,000	183,300	240,200	283,400
Production/inspection	43,400	53,900	64,500	78,300	99,600	114,300
Statistical work/computing	66,500	119,100	145,700	162,400	215,600	275,500
Physical scientists	154,900	168,200	166,300	210,500	234,000	264,900
Research	48,800	53,700	53,300	64,000	62,300	68,900
Basic research	18,300	18,900	19,100	22,300	23,500	27,500
Applied research	30,500	34,800	34,200	41,700	38,800	41,400
Development	21,300	27,500	27,300	34,000	35,100	43,600
Management of R&D	26,800	26,200	24,400	39,300	36,800	42,300
Management other than R&D	13,400	13,200	12,200	17,600	22,200	19,300
Teaching	16,200	18,900	19,700	27,800	36,400	44,200
Production/inspection	16,000	17,500	18,400	24,500	27,900	29,600
Statistical work/computing	3,100	3,400	3,500	4,800	5,500	6,500
Mathematical scientists	43,800	48,000	57,300	68,300	87,000	103,900
Research	6,000	6,100	6,900	8,700	9,800	11,600
Basic research	2,100	2,800	3,100	3,200	4,400	5,100
Applied research	3,900	3,300	3,800	5,500	5,400	6,500
Development	2,400	2,500	3,000	3,500	4,500	5,600
Management of R&D	6,500	6,500	7,200	6,900	13,300	13,800
Management other than R&D	5,900	5,800	6,700	5,700	8,700	9,400
Teaching	15,800	18,100	20,900	28,300	36,700	43,200
Production/inspection	1,200	900	1,200	800	1,900	2,600
Statistical work/computing	3,900	5,700	8,600	12,100	10,600	14,300
Computer specialists	116,000	171,400	196,700	216,100	340,400	437,200
Research	1,900	4,700	5,200	6,600	10,500	13,800
Basic research	400	700	800	1,100	2,700	3,500
Applied research	1,500	4,000	4,400	5,500	7,800	10,300
Development	25,400	28,000	32,700	43,200	64,200	87,300
Management of R&D	8,400	12,000	12,400	13,400	24,500	27,200
Management other than R&D	15,600	18,100	18,200	15,500	32,500	35,500
Teaching	3,500	4,200	4,600	5,500	12,800	16,300
Production/inspection	3,700	4,200	4,900	6,200	8,800	15,400
Statistical work/computing	38,200	82,400	100,000	107,600	160,800	206,000
Environmental scientists	46,600	56,900	63,100	82,700	89,900	97,300
Research	17,100	21,100	23,700	28,200	27,400	28,900
Basic research	5,600	5,000	5,800	7,700	10,700	9,700
Applied research	11,500	16,100	17,900	20,500	16,700	19,200
Development	3,400	5,700	7,000	9,100	7,000	6,200
Management of R&D	5,900	5,600	5,800	7,500	5,400	7,300
Management other than R&D	6,000	6,800	7,000	9,800	9,500	11,300
Teaching	2,400	3,100	3,300	5,100	6,900	8,200
Production/inspection	2,600	4,300	4,900	8,500	20,800	20,600
Statistical work/computing	2,000	3,800	4,400	5,400	5,800	6,300

Table B-5. - Continued

Field and primary work activity	1976	1978	1980	1982	1984	1986
Life scientists	198,200	227,800	267,300	298,000	294,100	340,500
Research	55,700	66,900	82,400	98,700	97,500	108,200
Basic research	24,500	31,500	40,500	49,200	50,400	55,000
Applied research	31,200	35,400	41,900	49,500	47,100	53,200
Development	6,700	10,200	12,100	13,600	13,100	14,600
Management of R&D	18,400	20,400	21,800	22,500	23,000	28,700
Management other than R&D	38,400	42,700	48,900	50,700	44,100	51,900
Teaching	28,100	34,400	38,700	45,200	52,800	58,700
Production/inspection	14,000	18,900	25,800	31,600	31,600	35,600
Statistical work/computing	3,200	6,900	8,400	8,100	7,400	9,100
Psychologists	103,700	107,400	112,500	105,600	151,900	172,800
Research	6,700	6,200	7,600	8,200	12,000	15,300
Basic research	3,100	3,300	4,000	3,700	6,700	6,800
Applied research	3,600	2,900	3,600	4,500	5,300	8,500
Development	1,200	2,100	2,100	1,900	1,600	2,300
Management of R&D	4,200	5,800	5,800	4,200	6,100	7,100
Management other than R&D	12,300	18,000	17,800	11,100	20,600	25,500
Teaching	20,900	21,400	23,600	26,400	33,600	38,200
Production/inspection	1,800	2,900	3,200	2,500	2,100	2,600
Statistical work/computing	1,100	2,300	2,800	2,300	2,900	2,800
Social scientists	180,500	157,800	169,700	166,200	205,600	259,800
Research	23,100	20,000	22,900	27,500	32,200	30,800
Basic research	5,600	5,100	6,600	7,500	10,400	9,300
Applied research	17,500	14,900	16,300	20,000	21,800	21,500
Development	1,000	3,800	4,300	4,800	5,700	6,400
Management of R&D	13,500	15,500	15,500	12,500	12,700	17,900
Management other than R&D	38,500	37,600	38,800	28,500	42,200	56,900
Teaching	44,600	39,600	39,200	45,100	61,000	74,600
Production/inspection	4,100	5,300	6,000	4,300	6,400	7,900
Statistical work/computing	15,100	14,500	17,900	22,000	22,700	30,500
Total engineers	1,278,300	1,426,900	1,509,900	1,719,000	2,062,200	2,243,500
Research	49,700	52,200	60,600	72,400	89,200	98,600
Basic research	5,600	4,900	7,100	8,400	10,600	12,200
Applied research	44,100	47,300	53,500	64,000	78,600	86,400
Development	368,900	406,600	461,600	545,100	627,000	680,800
Management of R&D	128,900	150,100	144,700	157,300	213,700	227,300
Management other than R&D	256,500	274,500	271,600	309,800	403,300	418,700
Teaching	20,700	22,000	23,500	27,700	45,800	53,100
Production/inspection	179,800	231,200	255,100	301,600	377,700	398,500
Statistical work/computing	34,600	57,600	66,400	73,000	89,900	108,900
Astronautical/aeronautical	55,700	61,100	65,000	77,200	91,800	104,200
Research	5,500	5,000	5,600	7,100	7,900	9,600
Basic research	900	200	500	800	800	1,500
Applied research	4,600	4,800	5,100	6,300	7,100	8,100
Development	20,100	20,800	22,800	29,600	36,400	39,700
Management of R&D	13,800	12,500	12,100	14,900	19,200	20,600
Management other than R&D	4,900	6,500	6,700	7,400	10,000	9,400
Teaching	1,000	1,300	1,300	1,100	2,100	2,400
Production/inspection	4,400	6,400	7,100	7,600	8,200	10,800
Statistical work/computing	1,800	3,400	4,300	4,400	4,700	5,700

Table B-5. - Continued

Field and primary work activity	1976	1978	1980	1982	1984	1986
Chemical	76,400	81,900	89,000	2,400	127,500	131,500
Research	4,400	3,200	4,300	800	8,400	8,300
Basic research	200	300	400	100	1,000	1,100
Applied research	4,200	2,900	3,900	700	7,400	7,200
Development	24,600	27,300	31,300	300	44,100	42,500
Management of R&D	8,600	9,000	9,000	0	14,400	18,400
Management other than R&D	19,300	16,800	16,900	200	26,800	24,400
Teaching	500	1,200	1,300	1,200	1,800	2,800
Production/inspection	9,900	13,600	15,200	0	22,200	20,500
Statistical work/computing	1,300	2,600	3,100	0	3,400	4,700
Civil	182,800	205,200	217,000	243,700	293,000	319,100
Research	2,900	3,100	3,900	4,500	6,700	7,300
Basic research	300	300	500	400	300	900
Applied research	2,600	2,800	3,400	4,100	6,400	6,400
Development	30,000	27,400	34,300	42,400	46,300	43,700
Management of R&D	6,000	8,500	8,400	8,800	13,200	10,300
Management other than R&D	57,400	64,800	64,600	70,300	91,500	103,400
Teaching	2,200	2,800	2,700	3,300	5,500	6,000
Production/inspection	37,500	38,400	42,200	50,400	65,300	69,500
Statistical work/computing	5,800	7,800	9,300	10,400	12,500	14,000
Electrical/electronics	267,900	327,000	357,400	413,500	475,000	540,800
Research	11,800	14,000	16,700	20,200	21,100	27,200
Basic research	1,400	1,400	2,100	2,700	2,000	3,300
Applied research	10,400	12,600	14,600	17,500	19,100	23,900
Development	101,400	121,800	140,800	168,800	185,700	209,700
Management of R&D	38,300	48,700	47,900	51,800	69,800	76,900
Management other than R&D	40,100	41,800	42,900	52,900	71,600	74,600
Teaching	4,400	5,100	5,800	6,800	9,900	12,700
Production/inspection	27,400	44,200	50,900	61,200	72,300	81,100
Statistical work/computing	6,300	10,800	12,700	14,500	17,500	22,700
Mechanical	272,800	296,500	308,800	334,400	414,000	453,700
Research	8,300	9,200	10,100	11,800	14,900	16,700
Basic research	700	700	900	1,300	2,400	2,400
Applied research	7,600	8,500	9,200	10,500	12,500	14,300
Development	106,700	113,000	124,700	143,000	167,400	187,300
Management of R&D	28,700	31,500	30,100	32,200	46,700	48,500
Management other than R&D	56,300	59,100	57,300	58,300	75,600	79,800
Teaching	5,300	5,400	5,300	5,800	9,100	8,900
Production/inspection	29,700	37,600	41,600	45,800	61,500	67,200
Statistical work/computing	3,100	7,200	7,700	6,900	8,200	11,800
Other engineers	422,700	455,200	472,700	647,800	660,900	694,200
Research	16,800	17,700	20,000	28,000	30,200	29,500
Basic research	2,100	2,000	2,700	3,100	4,100	3,000
Applied research	14,700	15,700	17,300	24,900	26,100	26,500
Development	86,100	96,300	107,700	161,000	147,100	157,900
Management of R&D	33,500	39,900	37,200	49,600	50,400	52,600
Management other than R&D	78,500	85,500	83,200	120,700	127,800	127,100
Teaching	7,300	6,200	7,100	9,500	17,400	20,300
Production/inspection	70,900	91,000	98,100	136,600	148,200	149,400
Statistical work/computing	16,300	25,800	29,300	36,800	43,600	50,000

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-6. Primary work activity for employed doctoral scientists and engineers by field: 1977-87

Field and primary work activity	1977	1979	1981	1983	1985	1987
Total scientists and engineers	285,055	314,257	343,956	369,320	400,358	419,118
Research	79,995	84,678	101,691	104,511	110,539	135,384
Basic research	43,551	47,908	55,181	57,137	61,451	63,230
Applied research	36,444	36,770	46,510	47,374	49,088	72,154
Development	13,188	15,009	18,361	20,277	21,976	18,909
Management of R&D	30,783	43,084	32,709	31,418	34,938	33,897
Management other than R&D	29,913	29,230	27,806	30,395	34,694	33,850
Teaching	90,830	92,242	105,150	108,236	111,717	109,730
Consulting	6,149	9,012	12,065	12,746	14,164	13,804
Sales/professional services 1/	15,233	21,126	25,757	29,820	36,496	32,644
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	11,891
Other 1/	18,964	19,876	20,417	31,917	35,834	29,009
Total scientists	240,005	263,915	286,917	307,775	334,505	351,350
Research	69,683	74,739	88,180	89,528	95,556	115,587
Basic research	41,892	45,953	52,404	54,038	57,833	59,716
Applied research	27,791	28,786	35,776	35,490	37,723	55,871
Development	6,349	7,185	8,487	10,514	11,185	9,083
Management of R&D	22,135	30,565	22,489	20,881	24,003	22,792
Management other than R&D	24,003	24,915	22,869	25,440	29,242	29,402
Teaching	82,029	82,909	94,416	96,403	99,237	97,938
Consulting	4,538	6,415	8,231	8,999	10,459	9,910
Sales/professional services 1/	14,568	20,029	24,271	28,568	34,252	32,500
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	10,527
Other 1/	16,700	17,158	17,974	27,442	30,571	23,611
Physical scientists	57,531	60,222	63,110	63,986	67,480	68,647
Research	22,271	21,135	26,515	25,569	26,253	30,750
Basic research	12,168	12,087	13,848	14,049	14,349	13,158
Applied research	10,103	9,048	12,667	11,520	11,904	17,592
Development	2,543	2,796	3,075	3,484	3,647	3,779
Management of R&D	8,464	12,644	8,785	8,793	9,370	8,184
Management other than R&D	4,718	3,523	3,165	3,052	3,627	2,750
Teaching	14,724	14,450	15,570	14,652	15,170	15,213
Consulting	407	761	1,112	925	1,206	1,390
Sales/professional services 1/	1,088	1,205	1,437	1,641	2,026	531
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	959
Other 1/	3,316	3,708	3,451	5,870	6,181	5,091
Mathematical scientists	14,609	15,250	15,569	16,379	16,758	16,699
Research	2,912	3,138	2,969	2,913	3,452	3,838
Basic research	1,830	2,073	1,741	1,767	2,323	2,835
Applied research	1,082	1,065	1,228	1,146	1,129	1,003
Development	408	492	395	490	573	161
Management of R&D	298	443	282	531	357	307
Management other than R&D	1,082	1,281	1,042	965	1,343	1,110
Teaching	9,088	8,865	9,596	9,701	9,445	9,347
Consulting	145	369	458	599	473	308
Sales/professional services 1/	78	249	300	261	213	22
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	808
Other 1/	598	413	527	919	902	798
Computer specialists	5,767	6,684	9,064	12,164	14,964	18,571
Research	777	909	1,515	1,508	1,970	3,415
Basic research	283	435	620	615	1,005	1,391
Applied research	494	474	895	893	965	2,024
Development	1,812	2,131	3,008	3,892	4,106	3,067
Management of R&D	735	971	808	1,114	1,734	2,292
Management other than R&D	667	681	890	938	1,128	1,348
Teaching	1,192	1,094	1,546	2,361	2,828	2,809
Consulting	155	301	554	678	914	825
Sales/professional services 1/	65	151	217	375	461	3
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	3,287
Other 1/	364	446	526	1,298	1,823	1,525

Table B-6. - Continued

Field and primary work activity	1977	1979	1981	1983	1985	1987
Environmental scientists	13,001	14,575	15,909	16,467	17,288	17,811
Research	4,674	5,242	6,036	6,399	6,501	7,567
Basic research	2,499	2,704	3,307	3,287	3,559	3,599
Applied research	2,175	2,538	2,729	3,112	2,942	3,968
Development	200	370	286	329	313	141
Management of R&D	1,631	2,361	2,380	1,825	2,058	1,937
Management other than R&D	1,448	1,193	1,166	1,304	1,400	1,647
Teaching	3,510	2,975	3,606	3,435	3,393	3,418
Consulting	364	838	1,045	1,198	1,407	1,402
Sales/professional services 1/	137	216	381	242	315	88
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	630
Other 1/	1,037	1,380	1,009	1,735	1,901	981
Life scientists	70,537	78,857	84,912	92,802	101,838	107,378
Research	27,868	31,905	37,962	39,491	42,865	51,701
Basic research	19,954	23,413	27,223	28,784	30,990	31,225
Applied research	7,914	8,492	10,739	10,707	11,875	20,476
Development	817	855	1,049	1,532	1,725	1,418
Management of R&D	7,340	9,246	6,711	6,165	7,328	7,310
Management other than R&D	6,206	6,613	5,416	6,806	8,335	8,233
Teaching	18,992	19,292	21,733	22,452	22,430	21,701
Consulting	1,037	1,441	1,535	1,981	2,383	2,258
Sales/professional services 1/	3,017	4,264	5,264	6,223	7,325	6,720
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	1,636
Other 1/	5,260	5,241	5,242	8,152	9,447	6,401
Psychologists	33,652	37,848	42,829	46,645	52,182	56,378
Research	3,705	4,535	4,970	4,704	4,765	6,107
Basic research	1,937	2,546	2,464	2,344	2,316	2,884
Applied research	1,768	1,989	2,506	2,360	2,449	3,223
Development	204	271	404	313	423	364
Management of R&D	1,609	1,620	1,060	903	1,043	1,030
Management other than R&D	4,297	5,002	4,745	4,705	5,152	5,695
Teaching	10,805	10,330	12,477	12,708	13,184	13,839
Consulting	1,481	1,499	2,051	2,084	2,118	1,576
Sales/professional services 1/	9,573	12,964	15,128	18,488	22,044	24,677
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	597
Other 1/	1,978	1,627	1,994	2,740	3,453	2,493
Social scientists	44,908	50,479	55,524	59,332	63,995	65,866
Research	7,476	7,875	8,213	8,944	9,750	12,209
Basic research	3,221	2,695	3,201	3,192	3,291	4,624
Applied research	4,255	5,180	5,012	5,752	6,459	7,585
Development	365	270	270	474	398	153
Management of R&D	2,058	3,280	2,463	1,550	2,113	1,732
Management other than R&D	5,585	6,622	6,445	7,670	8,257	8,619
Teaching	23,718	25,903	29,888	31,094	32,787	31,611
Consulting	949	1,206	1,476	1,534	1,958	2,151
Sales/professional services 1/	610	980	1,544	1,338	1,868	459
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	2,610
Other 1/	4,147	4,343	5,225	6,728	6,864	6,322
Total engineers	45,050	50,342	57,039	61,545	65,853	67,768
Research	10,312	9,939	13,511	14,983	14,983	19,797
Basic research	1,659	1,955	2,777	3,099	3,618	3,514
Applied research	8,653	7,984	10,734	11,884	11,365	16,283
Development	6,839	7,824	9,874	9,763	10,791	9,826
Management of R&D	8,648	12,519	10,220	10,537	10,935	11,105
Management other than R&D	5,910	4,315	4,937	4,955	5,452	4,448
Teaching	8,801	9,333	10,734	11,833	12,480	11,792
Consulting	1,611	2,597	3,834	3,747	3,705	3,894
Sales/professional services 1/	665	1,097	1,486	1,252	2,244	144
Rprt/stat/comput/activities	NA	NA	NA	NA	NA	1,364
Other 1/	2,264	2,718	2,443	4,475	5,263	5,398

Table B-6. - Continued

Field and primary work activity	1977	1979	1981	1983	1985	1987
Astronautical/aeronautical......	1,987	2,364	2,519	3,684	3,827	5,005
Research.......................	586	733	763	994	1,045	1,327
Basic research..............	104	293	175	273	300	231
Applied research............	482	440	588	721	745	1,096
Development....................	324	521	314	806	805	1,025
Management of R&D.............	454	574	620	798	931	1,446
Management other than R&D.....	195	86	218	156	176	224
Teaching.......................	336	310	387	517	335	436
Consulting.....................	0	0	40	138	127	207
Sales/professional services 1/	25	61	84	79	125	51
Rprt/stat/comput/activities...	NA	NA	NA	NA	NA	114
Other 1/.......................	67	79	93	196	283	175
Chemical........................	5,603	6,166	7,146	6,992	7,122	6,923
Research.......................	1,187	1,035	2,125	2,054	1,995	2,503
Basic research..............	199	175	278	374	446	488
Applied research............	988	860	1,847	1,680	1,549	2,015
Development....................	865	1,122	1,480	914	1,161	818
Management of R&D.............	1,301	1,809	1,192	1,110	1,214	968
Management other than R&D.....	903	662	432	587	542	390
Teaching.......................	713	620	963	1,078	904	1,110
Consulting.....................	182	217	387	227	225	195
Sales/professional services 1/	147	124	212	185	425	0
Rprt/stat/comput/activities...	NA	NA	NA	NA	NA	103
Other 1/.......................	305	577	355	837	656	836
Civil...........................	4,066	5,157	6,089	5,317	6,396	6,479
Research.......................	565	705	704	580	822	1,234
Basic research..............	55	36	134	189	298	276
Applied research............	510	669	570	391	524	958
Development....................	285	252	514	318	530	224
Management of R&D.............	377	432	443	180	470	228
Management other than R&D.....	710	624	770	598	668	781
Teaching.......................	1,470	1,633	2,164	2,132	2,231	2,369
Consulting.....................	347	1,073	983	934	788	871
Sales/professional services 1/	60	165	233	113	318	8
Rprt/stat/comput/activities...	NA	NA	NA	NA	NA	60
Other 1/.......................	252	273	278	462	569	704
Electrical/electronics..........	8,284	8,597	10,630	12,696	14,248	12,601
Research.......................	1,418	1,327	1,976	2,455	2,344	2,737
Basic research..............	218	100	273	330	493	494
Applied research............	1,200	1,227	1,703	2,125	1,851	2,243
Development....................	1,832	1,454	2,429	2,551	2,943	2,966
Management of R&D.............	1,631	2,534	2,128	2,817	2,899	2,197
Management other than R&D.....	959	826	836	1,144	1,273	760
Teaching.......................	1,897	1,842	2,313	2,447	3,028	2,153
Consulting.....................	84	123	377	380	422	468
Sales/professional services 1/	106	186	242	247	423	26
Rprt/stat/comput/activities...	NA	NA	NA	NA	NA	224
Other 1/.......................	357	305	329	655	916	1,070
Mechanical......................	4,648	5,245	5,370	5,657	6,594	6,711
Research.......................	931	778	1,219	836	1,214	1,850
Basic research..............	134	172	344	156	376	244
Applied research............	797	606	875	680	838	1,606
Development....................	598	853	1,015	1,055	1,264	838
Management of R&D.............	826	1,023	660	597	896	697
Management other than R&D.....	579	392	379	491	529	411
Teaching.......................	1,267	1,582	1,501	1,867	2,025	2,109
Consulting.....................	164	364	378	342	340	330
Sales/professional services 1/	61	178	132	65	113	0
Rprt/stat/comput/activities...	NA	NA	NA	NA	NA	88
Other 1/.......................	222	75	86	404	213	388

Table B-6. - Continued

Field and primary work activity	1977	1979	1981	1983	1985	1987
Other engineers..................	20,462	22,813	25,285	27,199	27,666	30,049
Research........................	5,625	5,361	6,724	8,064	7,563	10,146
Basic research...............	949	1,179	1,573	1,777	1,705	1,781
Applied research.............	4,676	4,182	5,151	6,287	5,858	8,365
Development.....................	2,935	3,622	4,122	4,119	4,088	3,955
Management of R&D..............	4,059	6,147	5,177	5,035	4,525	5,569
Management other than R&D.....	2,564	1,725	2,302	1,979	2,264	1,882
Teaching........................	3,118	3,346	3,406	3,792	3,957	3,615
Consulting......................	834	820	1,669	1,726	1,803	1,823
Sales/professional services 1/	266	383	583	563	840	59
Rprt/stat/comput/activities...	NA	NA	NA	NA	NA	775
Other 1/........................	1,061	1,409	1,302	1,921	2,626	2,225

1/ Sales/professional services in 1987 is redefined to only professional services, sales is now included with other.

NOTE: Because of rounding, components may not add to totals. NA = Not Available.

SOURCE: National Science Foundation, SRS.

Table B-7. Types of employers for scientists and engineers employed in science/engineering jobs by field: 1976-86

Field and type of employer	1976	1978	1980	1982	1984	1986
Total scientists and engineers	2,122,100	2,364,400	2,542,700	2,866,600	3,465,100	3,919,900
Business and industry	1,312,500	1,562,300	1,684,600	1,899,300	2,312,700	2,589,300
Educational Institutions	267,800	281,800	304,700	362,700	500,600	572,700
Federal Government	211,100	218,300	234,300	270,200	290,800	334,200
State and local government	126,600	131,600	141,500	157,100	177,800	221,900
Nonprofit organizations	79,000	78,900	87,900	98,700	128,100	143,900
Other	125,100	91,500	89,700	78,600	55,100	57,900
Total scientists	843,800	937,500	1,032,800	1,147,500	1,402,900	1,676,400
Business and industry	357,900	442,300	491,700	516,100	654,400	797,900
Educational institutions	230,100	246,000	265,400	316,800	423,400	481,800
Federal Government	105,200	109,500	119,900	141,500	130,000	153,500
State and local government	54,600	58,900	67,000	74,000	79,400	110,900
Nonprofit organizations	57,500	59,900	67,700	75,700	94,200	109,600
Other	38,500	20,900	21,100	23,400	21,500	22,700
Physical scientists	154,900	168,200	166,300	210,500	234,000	264,900
Business and industry	86,800	98,400	96,800	124,400	131,200	146,700
Educational institutions	30,600	32,500	33,800	46,600	59,500	68,700
Federal Government	20,500	20,500	19,700	23,400	23,800	28,600
State and local government	5,000	5,600	5,700	5,900	7,900	8,300
Nonprofit organizations	6,800	6,700	6,300	8,100	9,300	8,500
Other	5,200	4,500	4,000	2,100	2,300	4,100
Mathematical scientists	43,800	48,000	57,300	68,300	87,000	103,900
Business and industry	12,100	14,500	18,700	18,600	30,700	35,600
Educational institutions	19,500	22,400	26,100	34,800	44,300	52,800
Federal Government	9,300	7,900	8,500	10,500	8,300	10,700
State and local government	1,100	1,100	1,400	1,500	1,100	1,800
Nonprofit organizations	800	1,200	1,600	1,800	1,900	2,400
Other	1,000	900	1,000	1,100	700	600
Computer specialists	116,000	171,400	196,700	216,100	340,400	437,200
Business and industry	85,800	132,900	153,400	170,500	264,700	341,300
Educational institutions	6,000	10,700	11,900	13,300	25,700	32,500
Federal Government	8,700	13,200	14,500	15,100	24,100	32,100
State and local government	5,000	6,100	7,000	7,700	10,400	15,200
Nonprofit organizations	5,600	6,200	7,100	6,100	10,600	10,400
Other	4,900	2,300	2,800	3,400	4,900	5,700
Environmental scientists	46,600	56,900	63,100	82,700	89,900	97,300
Business and industry	25,800	33,400	37,900	51,400	51,600	55,500
Educational institutions	5,000	7,600	7,700	10,300	14,900	16,500
Federal Government	9,300	11,200	12,300	14,500	14,900	16,800
State and local government	1,800	2,900	3,200	4,000	5,400	5,600
Nonprofit organizations	1,500	700	700	800	1,200	1,000
Other	3,200	1,100	1,300	1,700	1,900	1,900
Life scientists	198,200	227,800	267,300	298,000	294,100	340,500
Business and industry	64,100	71,300	85,000	82,400	84,300	102,800
Educational institutions	59,600	74,100	87,100	104,200	121,900	136,500
Federal Government	37,300	39,800	46,400	54,800	37,900	40,200
State and local government	19,900	24,100	27,100	32,400	23,300	30,800
Nonprofit organizations	11,300	14,500	17,900	20,000	22,300	25,800
Other	6,000	4,000	3,800	4,200	4,400	4,400
Psychologists	103,700	107,400	112,500	105,600	151,900	172,800
Business and industry	21,000	33,900	33,900	22,300	34,000	39,700
Educational institutions	41,700	43,500	44,900	46,900	69,400	72,800
Federal Government	5,000	2,000	2,000	2,800	4,400	5,400
State and local government	6,700	6,500	6,700	7,300	10,000	14,200
Nonprofit organizations	19,100	18,200	21,700	23,600	32,500	39,100
Other	10,200	3,300	3,300	2,700	1,600	1,600

Table B-7. - Continued

Field and type of employer	1976	1978	1980	1982	1984	1986
Social scientists	180,500	157,800	169,700	166,200	205,600	259,800
Business and industry	62,300	57,800	66,000	46,400	58,000	76,200
Educational institutions	67,800	55,300	53,800	60,800	87,700	102,000
Federal Government	15,100	14,900	16,400	20,500	16,600	19,700
State and local government	15,200	12,500	15,900	15,200	21,200	35,100
Nonprofit organizations	12,500	12,400	12,500	15,200	16,200	22,500
Other	7,600	4,900	5,100	8,100	5,900	4,300
Total engineers	1,278,300	1,426,900	1,509,900	1,719,000	2,062,200	2,243,500
Business and industry	954,600	1,120,000	1,192,900	1,383,200	1,658,300	1,791,400
Educational institutions	37,700	35,800	39,300	45,800	77,200	90,900
Federal Government	105,900	108,800	114,400	128,700	160,800	180,700
State and local government	72,000	72,700	74,500	83,200	98,400	111,000
Nonprofit organizations	21,500	19,000	20,200	23,000	33,800	34,200
Other	86,600	70,600	68,600	55,100	33,700	35,300
Astronautical/aeronautical	55,700	61,100	65,000	77,200	91,800	104,200
Business and industry	39,900	43,900	46,500	57,500	69,200	77,400
Educational institutions	1,800	1,600	2,100	2,000	2,900	3,600
Federal Government	11,100	10,700	11,300	12,900	15,800	17,500
State and local government	700	900	800	400	100	400
Nonprofit organizations	700	900	900	1,000	2,200	2,800
Other	1,500	3,100	3,400	3,400	1,600	2,500
Chemical	76,400	81,900	89,000	101,000	127,500	131,500
Business and industry	68,400	72,100	78,500	91,500	115,000	114,200
Educational institutions	900	1,800	2,700	2,400	3,800	5,400
Federal Government	2,600	2,900	2,900	2,900	4,700	6,600
State and local government	1,100	800	800	800	900	1,700
Nonprofit organizations	1,100	900	1,000	1,300	2,100	2,500
Other	2,300	3,400	3,100	2,100	1,000	1,100
Civil	182,800	205,200	217,000	243,700	293,000	319,100
Business and industry	85,100	120,300	129,500	147,300	179,900	195,700
Educational institutions	5,300	4,100	4,200	5,200	9,100	8,800
Federal Government	21,500	21,000	22,400	24,000	28,500	31,600
State and local government	50,000	49,200	50,600	56,000	67,200	74,600
Nonprofit organizations	2,000	1,100	1,100	1,500	1,300	1,800
Other	18,900	9,500	9,200	9,700	7,000	6,600
Electrical/electronics	267,900	327,000	357,400	413,500	475,000	540,800
Business and industry	210,600	261,300	288,500	338,300	391,200	439,800
Educational institutions	10,400	9,100	10,100	12,200	18,800	24,600
Federal Government	27,600	29,600	31,800	38,200	44,500	52,700
State and local government	4,000	3,800	3,800	4,500	4,600	6,000
Nonprofit organizations	3,900	5,800	6,300	7,300	7,900	8,800
Other	11,400	17,400	16,900	13,000	8,000	8,900
Mechanical	272,800	296,500	308,800	334,400	414,000	453,700
Business and industry	227,900	255,000	266,400	292,300	361,100	394,500
Educational institutions	8,500	8,300	8,500	9,400	15,500	17,000
Federal Government	15,300	15,400	16,300	17,800	24,100	28,700
State and local government	3,100	2,800	2,900	3,100	3,000	3,600
Nonprofit organizations	6,300	3,000	3,100	3,500	5,200	5,500
Other	11,700	12,000	11,600	8,300	5,100	4,400
Other engineers	422,700	455,200	472,700	549,200	660,900	694,200
Business and industry	322,700	367,400	383,500	456,300	541,900	569,800
Educational institutions	10,700	10,900	11,700	14,600	27,100	31,500
Federal Government	27,800	29,200	29,700	32,900	43,200	43,600
State and local government	13,000	15,200	15,600	18,400	22,600	24,700
Nonprofit organizations	7,400	7,300	7,800	8,400	15,100	12,800
Other	40,800	25,200	24,400	18,600	11,000	11,800

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-8. Types of employers for doctoral scientists and engineers by field: 1977-87

Field and type of employer	1977	1979	1981	1983	1985	1987
Total scientists and engineers	285,055	314,257	343,956	369,320	400,358	419,118
Business and industry	71,562	82,858	99,126	113,463	125,767	131,699
Educational institutions	163,768	174,483	187,011	196,050	211,611	218,697
Federal Government	21,389	23,946	25,124	25,793	26,337	27,532
State and local government	5,308	6,123	6,558	7,717	8,217	9,223
Nonprofit organizations	10,195	12,454	12,601	11,894	13,617	15,464
Other	12,833	14,393	13,536	14,403	14,809	16,503
Total scientists	240,005	263,915	286,917	307,775	334,505	351,350
Business and industry	48,694	56,341	67,338	78,963	87,909	94,552
Educational institutions	147,851	157,409	168,969	175,730	189,914	194,987
Federal Government	17,870	20,375	21,321	21,950	22,530	23,926
State and local government	4,924	5,882	6,201	7,334	7,855	8,697
Nonprofit organizations	8,644	10,438	10,263	9,973	11,903	13,290
Other	12,022	13,470	12,825	13,825	14,394	15,898
Physical scientists	57,531	60,222	63,110	63,986	67,480	68,647
Business and industry	23,006	24,989	27,409	28,748	30,281	30,741
Educational institutions	27,118	27,300	28,225	27,931	29,700	30,310
Federal Government	3,945	4,598	4,342	4,307	4,044	4,322
State and local government	276	279	358	246	344	448
Nonprofit organizations	2,042	1,985	2,093	1,751	2,286	2,167
Other	1,144	1,071	683	1,003	825	659
Mathematical scientists	14,609	15,250	15,569	16,379	16,758	16,699
Business and industry	1,312	1,469	1,616	2,027	1,911	1,838
Educational institutions	12,223	12,550	12,719	13,244	13,560	13,674
Federal Government	604	817	852	790	853	848
State and local government	51	51	2	21	34	26
Nonprofit organizations	261	294	263	211	293	151
Other	158	69	117	86	107	162
Computer specialists	5,767	6,684	9,064	12,164	14,964	18,571
Business and industry	3,058	3,669	5,228	6,819	8,351	11,383
Educational institutions	2,128	2,404	3,010	4,031	5,288	5,558
Federal Government	251	336	355	490	692	797
State and local government	81	7	152	336	248	258
Nonprofit organizations	159	163	276	345	329	444
Other	90	105	43	143	56	131
Environmental scientists	13,001	14,575	15,909	16,467	17,288	17,811
Business and industry	3,103	4,246	4,705	5,154	5,254	5,168
Educational institutions	6,285	6,146	6,741	6,682	7,222	7,483
Federal Government	2,417	2,716	3,075	3,102	3,309	3,363
State and local government	506	655	604	819	666	913
Nonprofit organizations	520	614	623	555	678	702
Other	170	198	161	155	159	182
Life scientists	70,537	78,857	84,912	92,802	101,838	107,378
Business and industry	9,734	11,145	13,123	16,444	19,165	20,455
Educational institutions	46,865	51,673	55,762	58,906	63,595	66,415
Federal Government	6,372	7,167	7,225	7,771	7,962	8,709
State and local government	1,452	1,551	1,670	1,710	2,166	1,944
Nonprofit organizations	2,401	2,970	3,150	3,258	3,884	4,256
Other	3,713	4,351	3,982	4,713	5,066	5,599
Psychologists	33,652	37,848	42,829	46,645	52,182	56,378
Business and industry	5,528	7,077	10,122	13,020	15,530	17,381
Educational institutions	18,512	19,846	21,675	22,182	24,893	25,369
Federal Government	1,220	1,080	1,211	1,191	1,049	1,388
State and local government	1,336	1,680	1,715	2,148	1,916	2,197
Nonprofit organizations	1,272	1,725	1,679	1,773	2,084	2,501
Other	5,784	6,440	6,427	6,331	6,710	7,542

Table B-8. - Continued

Field and type of employer	1977	1979	1981	1983	1985	1987
Social scientists	44,908	50,479	55,524	59,332	63,995	65,866
Business and industry	2,953	3,746	5,135	6,751	7,417	7,586
Educational institutions	34,720	37,490	40,837	42,754	45,656	46,178
Federal Government	3,061	3,661	4,261	4,299	4,621	4,499
State and local government	1,222	1,659	1,700	2,054	2,481	2,911
Nonprofit organizations	1,989	2,687	2,179	2,080	2,349	3,069
Other	963	1,236	1,412	1,394	1,471	1,623
Total engineers	45,050	50,342	57,039	61,545	65,853	67,768
Business and industry	22,868	26,517	31,788	34,500	37,858	37,147
Educational institutions	15,917	17,074	18,042	20,320	21,697	23,710
Federal Government	3,519	3,571	3,803	3,843	3,807	3,606
State and local government	384	241	357	383	362	526
Nonprofit organizations	1,551	2,016	2,338	1,921	1,714	2,174
Other	811	923	711	578	415	605
Astronautical/aeronautical	1,987	2,364	2,519	3,684	3,827	5,005
Business and industry	799	907	1,127	1,928	2,095	3,177
Educational institutions	561	783	675	865	732	907
Federal Government	381	407	425	511	627	550
State and local government	0	0	0	1	0	0
Nonprofit organizations	63	134	176	305	271	327
Other	183	133	116	74	102	44
Chemical	5,603	6,166	7,146	6,992	7,122	6,923
Business and industry	4,099	4,540	5,342	4,788	5,097	4,690
Educational institutions	1,180	1,129	1,380	1,722	1,778	1,941
Federal Government	210	260	258	174	183	164
State and local government	8	0	23	0	0	0
Nonprofit organizations	96	191	143	202	64	75
Other	10	46	0	106	0	53
Civil	4,066	5,157	6,089	5,317	6,396	6,479
Business and industry	1,199	1,822	2,555	1,895	2,426	1,931
Educational institutions	2,211	2,722	2,887	3,138	3,409	3,802
Federal Government	279	249	145	79	295	387
State and local government	244	131	192	146	162	262
Nonprofit organizations	13	0	69	16	14	49
Other	120	233	241	43	90	48
Electrical/electronics	8,284	8,597	10,630	12,696	14,248	12,601
Business and industry	3,915	4,687	6,187	7,615	8,566	7,600
Educational institutions	3,290	2,930	3,592	3,960	4,672	3,979
Federal Government	620	719	524	776	756	637
State and local government	13	17	60	62	46	35
Nonprofit organizations	320	184	264	218	186	254
Other	126	60	3	65	22	96
Mechanical	4,648	5,245	5,370	5,657	6,594	6,711
Business and industry	2,108	2,419	2,645	2,596	3,094	2,641
Educational institutions	2,038	2,235	2,138	2,578	2,973	3,544
Federal Government	319	338	322	353	308	311
State and local government	0	1	2	0	0	8
Nonprofit organizations	183	228	263	107	194	179
Other	0	24	0	23	25	28
Other engineers	20,462	22,813	25,285	27,199	27,666	30,049
Business and industry	10,748	12,142	13,932	15,678	16,580	17,108
Educational institutions	6,637	7,275	7,370	8,057	8,133	9,537
Federal Government	1,710	1,598	2,129	1,950	1,638	1,557
State and local government	119	92	80	174	154	221
Nonprofit organizations	876	1,279	1,423	1,073	985	1,290
Other	372	427	351	267	176	336

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-9. Total employed scientists and engineers by field and racial/ethnic group: 1976-88

Field and racial/ethnic group	1976	1978	1980	1982	1984	1986	1988 1/
Total scientists and engineers...	2,331,200	2,609,800	2,860,400	3,253,100	3,995,500	4,626,500	5,286,400
White..........................	2,141,900	2,416,500	2,644,900	2,992,000	3,641,200	4,190,400	4,761,900
Black..........................	38,100	47,700	57,600	71,500	90,500	114,900	139,200
Asian..........................	106,600	108,800	121,000	134,600	186,500	226,800	268,100
Other..........................	44,600	36,800	36,900	55,000	77,300	94,400	117,200
Total scientists................	959,500	1,071,000	1,184,500	1,405,700	1,781,400	2,186,300	2,567,800
White..........................	870,900	989,800	1,097,000	1,294,200	1,623,800	1,973,100	2,299,400
Black..........................	21,400	26,900	30,500	40,000	53,400	73,700	94,800
Asian..........................	48,500	38,800	41,500	48,000	69,100	94,000	117,100
Other..........................	18,700	15,500	15,500	23,500	35,100	45,500	56,500
Physical scientists............	188,900	208,300	215,200	227,400	254,100	288,400	312,000
White........................	172,400	194,500	201,200	212,700	230,700	261,800	279,500
Black........................	3,200	3,500	3,400	3,500	6,100	6,200	6,500
Asian........................	7,600	8,700	8,800	8,200	12,500	15,400	20,600
Other........................	5,700	1,600	1,800	3,000	4,800	5,000	5,400
Mathematical scientists........	48,600	53,700	64,300	79,400	100,400	131,000	168,600
White........................	44,200	49,400	59,200	72,300	88,900	115,500	145,700
Black........................	2,600	2,800	2,900	3,600	4,700	6,800	9,500
Asian........................	1,600	1,500	2,100	2,700	4,700	5,900	9,200
Other........................	200	0	100	800	2,100	2,800	4,200
Computer specialists...........	119,000	177,000	207,800	299,000	436,800	562,600	708,300
White........................	110,700	164,500	192,000	272,300	392,600	497,100	625,300
Black........................	1,600	3,200	4,700	8,900	12,100	18,900	26,000
Asian........................	4,000	8,400	9,900	13,100	24,600	36,100	46,900
Other........................	2,700	900	1,200	4,700	7,500	10,500	10,100
Environmental scientists.......	54,800	68,900	77,600	87,200	98,100	111,300	113,400
White........................	48,300	60,400	70,000	80,900	94,200	105,800	107,100
Black........................	2,000	700	700	600	600	1,000	1,000
Asian........................	3,200	1,900	2,500	3,600	1,800	2,100	1,600
Other........................	1,300	5,900	4,400	2,100	1,500	2,400	3,700
Life scientists................	213,500	244,100	287,500	337,100	353,300	411,800	458,600
White........................	200,700	229,100	270,300	316,900	329,300	377,900	413,900
Black........................	4,900	5,700	6,700	8,000	6,700	8,800	9,500
Asian........................	5,300	6,300	7,100	7,800	10,400	15,000	20,100
Other........................	2,600	3,000	3,400	4,400	6,900	10,100	15,100
Psychologists..................	112,500	121,700	128,100	138,400	209,500	253,500	275,900
White........................	105,100	115,300	121,600	130,400	196,000	234,100	256,000
Black........................	3,800	3,800	3,800	4,500	7,300	9,100	10,100
Asian........................	1,000	700	1,200	1,200	2,000	5,200	4,600
Other........................	2,600	1,900	1,500	2,300	4,200	5,100	5,200
Social scientists..............	222,300	197,400	204,000	237,200	329,200	427,800	531,000
White........................	189,400	176,700	182,800	208,700	292,100	380,800	472,000
Black........................	3,300	7,200	8,300	10,900	15,900	22,900	32,300
Asian........................	25,800	11,300	10,000	11,300	13,100	14,200	14,200
Other........................	3,800	2,200	2,900	6,300	8,100	9,900	12,500
Total engineers.................	1,371,700	1,538,800	1,675,900	1,847,300	2,214,100	2,440,100	2,718,600
White..........................	1,271,000	1,426,700	1,547,800	1,697,800	2,017,400	2,217,300	2,462,500
Black..........................	16,700	20,800	27,000	31,500	37,100	41,300	44,400
Asian..........................	58,100	70,000	79,500	86,700	117,500	132,800	151,000
Other..........................	25,900	21,300	21,600	31,300	42,100	48,700	60,700
Astronautical/aeronautical.....	56,800	62,000	69,500	80,800	97,200	110,500	119,400
White........................	54,100	57,800	65,000	76,000	90,200	100,800	106,900
Black........................	300	1,000	1,100	1,200	1,200	1,600	1,600
Asian........................	1,600	2,000	2,200	2,600	4,900	6,600	9,300
Other........................	800	1,200	1,200	1,000	900	1,500	1,600

Table B-9. - Continued

Field and racial/ethnic group	1976	1978	1980	1982	1984	1986	1988 1/
Chemical	77,500	84,200	94,500	107,700	140,100	149,000	148,500
White	72,200	78,300	86,400	97,700	125,100	133,900	136,000
Black	1,500	300	800	1,000	1,500	2,000	1,700
Asian	2,400	4,000	5,800	7,300	10,300	10,100	8,000
Other	1,400	1,600	1,500	1,700	3,200	3,000	2,800
Civil	188,200	211,700	232,100	258,200	312,700	346,300	355,900
White	165,700	191,300	209,100	231,100	275,000	308,600	316,100
Black	1,600	2,700	3,900	3,700	4,800	5,200	6,200
Asian	14,800	14,800	16,000	17,700	23,800	24,500	25,400
Other	6,100	2,900	3,100	5,700	9,100	8,000	8,200
Electrical/electronics	283,000	341,500	383,100	437,700	500,700	574,500	640,900
White	262,500	310,700	346,500	397,200	447,700	512,100	570,700
Black	2,900	5,800	8,100	9,700	11,400	11,900	11,000
Asian	13,800	20,200	23,300	23,800	31,100	37,900	44,000
Other	3,800	4,800	5,200	7,000	10,500	12,600	15,200
Mechanical	276,200	299,300	322,600	357,900	445,600	492,600	497,800
White	258,700	280,200	302,000	332,800	412,100	452,600	455,700
Black	2,400	2,300	2,700	3,800	4,800	6,700	7,100
Asian	9,700	12,800	13,900	15,600	21,300	24,600	26,300
Other	5,400	4,000	4,000	5,700	7,400	8,700	8,700
Other engineers	490,000	540,100	574,100	605,000	717,800	767,200	956,100
White	457,800	508,400	538,800	563,000	667,300	709,300	877,100
Black	8,000	8,700	10,400	12,100	13,400	13,900	16,800
Asian	15,800	16,200	18,300	19,700	26,100	29,100	38,000
Other	8,400	6,800	6,600	10,200	11,000	14,900	24,200

1/ 1988 data are model generated rather than survey generated estimates and therefore trends (especially short term) should be treated with caution.

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-10. Scientists and engineers employed in science/engineering jobs by field and racial/ethnic group: 1976-86

Field and racial/ethnic group	1976	1978	1980	1982	1984	1986
Total scientists and engineers.....	2,122,100	2,364,400	2,542,700	2,866,700	3,465,100	3,919,900
White............................	1,949,700	2,189,600	2,349,700	2,638,200	3,159,500	3,556,200
Black............................	34,900	43,000	50,900	59,000	73,600	87,900
Asian............................	98,500	102,800	112,000	122,500	169,400	199,000
Other............................	39,000	29,000	30,100	47,000	62,600	76,800
Total scientists..................	843,800	937,500	1,032,800	1,147,500	1,402,900	1,676,400
White............................	764,200	868,500	957,900	1,058,300	1,281,900	1,521,000
Black............................	19,400	23,200	26,000	30,000	39,000	50,600
Asian............................	43,100	35,700	37,500	40,700	57,500	72,300
Other............................	17,100	10,100	11,400	18,500	24,500	32,500
Physical scientists..............	154,900	168,200	166,300	210,500	234,000	264,900
White..........................	141,200	157,600	155,600	197,700	213,100	240,400
Black..........................	2,400	2,500	2,400	2,900	4,800	5,400
Asian..........................	6,400	7,300	7,100	7,400	11,500	14,500
Other..........................	4,900	800	1,200	2,500	4,600	4,600
Mathematical scientists..........	43,800	48,000	57,300	68,300	87,000	103,900
White..........................	39,400	44,100	52,600	61,800	76,300	91,300
Black..........................	2,500	2,400	2,500	3,400	4,400	6,100
Asian..........................	1,700	1,500	2,100	2,500	4,500	4,200
Other..........................	200	0	100	600	1,800	2,300
Computer specialists.............	116,000	171,400	196,700	216,100	340,400	437,200
White..........................	108,000	159,100	181,500	196,000	305,000	388,200
Black..........................	1,500	3,200	4,300	6,200	9,900	13,200
Asian..........................	3,900	8,200	9,700	10,400	20,800	27,600
Other..........................	2,600	900	1,200	3,500	4,700	8,200
Environmental scientists.........	46,600	56,900	63,100	82,700	89,900	97,300
White..........................	40,700	51,600	57,700	76,700	56,100	93,600
Black..........................	1,800	1,000	800	400	600	400
Asian..........................	2,900	1,600	2,000	3,600	1,700	1,900
Other..........................	1,200	2,700	2,600	2,000	31,500	1,400
Life scientists..................	198,200	227,800	267,300	298,000	294,100	340,500
White..........................	186,100	213,200	250,700	280,400	273,800	313,100
Black..........................	4,700	5,300	6,400	7,500	5,400	7,100
Asian..........................	5,400	6,300	6,900	6,500	9,300	12,900
Other..........................	2,000	3,000	3,300	3,600	5,600	7,400
Psychologists....................	103,700	107,400	112,500	105,600	151,900	172,800
White..........................	97,100	102,400	107,400	100,700	143,000	161,800
Black..........................	3,700	3,400	3,400	2,400	5,100	6,000
Asian..........................	700	700	1,000	1,000	1,400	1,400
Other..........................	2,200	900	700	1,500	2,400	3,600
Social scientists................	180,500	157,800	169,700	166,200	205,600	259,800
White..........................	151,600	140,500	152,600	145,100	184,700	232,600
Black..........................	2,900	5,500	6,400	7,200	8,900	12,300
Asian..........................	22,100	10,300	8,700	9,300	8,100	9,700
Other..........................	3,900	1,500	2,000	4,600	3,900	5,200
Total engineers..................	1,278,300	1,426,900	1,509,900	1,719,100	2,062,200	2,243,500
White............................	1,185,500	1,321,100	1,391,700	1,579,800	1,877,600	2,035,200
Black............................	15,500	19,800	24,900	29,000	34,500	37,300
Asian............................	55,400	67,100	74,600	81,700	112,000	126,700
Other............................	21,900	18,900	18,700	28,600	38,100	44,300
Astronautical/aeronautical.......	55,700	61,100	65,000	77,200	91,800	104,200
White..........................	52,900	56,800	60,500	72,700	86,000	94,900
Black..........................	300	1,000	1,200	1,100	1,000	1,400
Asian..........................	1,700	2,100	2,100	2,600	4,100	6,500
Other..........................	800	1,200	1,200	800	700	1,400

Table B-10. - Continued

Field and racial/ethnic group	1976	1978	1980	1982	1984	1986
Chemical	76,400	81,900	89,000	101,100	127,500	131,500
White	71,100	76,000	81,300	91,800	113,700	119,200
Black	1,500	300	400	900	1,200	900
Asian	2,400	4,000	5,700	6,800	10,000	9,200
Other	1,400	1,600	1,600	1,600	2,600	2,200
Civil	182,800	205,200	217,000	243,700	293,000	319,100
White	162,500	185,000	194,900	218,500	258,100	284,300
Black	1,800	2,700	3,800	3,600	4,500	4,800
Asian	14,800	14,500	15,200	16,500	23,000	23,300
Other	3,700	3,000	3,100	5,100	7,400	6,700
Electrical/electronics	267,900	327,000	357,400	413,500	475,000	540,800
White	248,800	297,900	323,600	375,100	424,800	481,800
Black	2,600	5,700	7,500	8,800	10,600	11,000
Asian	12,700	19,500	22,100	23,100	29,400	36,000
Other	3,800	3,900	4,200	6,500	10,200	12,000
Mechanical	272,800	296,500	308,800	334,400	414,000	453,700
White	255,300	277,400	288,900	310,800	382,300	416,000
Black	2,200	2,100	2,500	3,400	4,500	6,400
Asian	9,600	12,800	13,600	14,600	20,000	23,400
Other	5,700	4,200	3,800	5,600	7,200	7,900
Other engineers	422,700	455,200	472,700	549,200	660,900	694,200
White	394,900	428,000	442,500	510,900	612,700	639,000
Black	7,100	8,000	9,500	11,200	12,700	12,800
Asian	14,200	14,200	15,900	18,100	25,500	28,300
Other	6,500	5,000	4,800	9,000	10,000	14,100

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-11. Employed doctoral scientists and engineers by field and racial/ethnic groups: 1977-87

Field and racial/ethnic groups	1977	1979	1981	1983	1985	1987
Total scientists and engineers	285,055	314,257	343,953	369,320	400,358	419,118
White	258,255	284,965	309,123	328,455	355,125	372,985
Black	2,709	3,227	4,224	4,948	5,716	6,359
Asian	16,275	22,912	27,350	29,740	34,533	36,397
Other	7,816	3,153	3,256	6,177	4,984	3,377
Total scientists	240,005	263,915	286,917	307,775	334,505	351,350
White	219,636	243,008	261,912	278,722	302,526	319,091
Black	2,588	3,125	3,954	4,538	5,203	5,704
Asian	11,229	15,037	18,328	19,259	22,651	23,645
Other	6,552	2,745	2,723	5,256	4,125	2,910
Physical scientists	57,531	60,222	63,110	63,986	67,480	68,647
White	51,963	54,618	56,245	56,521	59,598	60,751
Black	543	403	579	690	522	620
Asian	3,441	4,719	5,769	5,684	6,561	6,788
Other	1,584	482	517	1,091	799	488
Mathematical scientists	14,609	15,250	15,569	16,379	16,758	16,699
White	13,218	13,729	13,975	14,531	14,921	14,940
Black	120	144	167	178	166	166
Asian	799	1,110	1,155	1,378	1,368	1,482
Other	472	267	272	292	303	111
Computer specialists	5,767	6,684	9,064	12,164	14,964	18,571
White	5,014	6,059	8,056	11,012	13,064	16,219
Black	15	4	27	43	85	200
Asian	613	561	868	944	1,634	1,838
Other	125	60	113	165	181	314
Environmental scientists	13,001	14,575	15,909	16,467	17,288	17,811
White	12,125	13,813	14,996	15,476	15,774	16,587
Black	24	65	34	33	98	222
Asian	572	539	744	770	1,133	943
Other	280	158	135	188	283	59
Life scientists	70,537	78,857	84,912	92,802	101,838	107,378
White	64,243	71,861	77,089	83,378	92,002	96,955
Black	769	883	1,013	1,142	1,419	1,456
Asian	3,980	5,417	6,257	6,750	7,412	8,207
Other	1,545	696	553	1,532	1,005	760
Psychologists	33,652	37,848	42,829	46,645	52,182	56,378
White	31,943	36,480	9,825	44,237	49,508	53,655
Black	467	594	809	983	1,190	1,266
Asian	313	412	583	640	756	858
Other	929	362	31,612	785	728	599
Social scientists	44,908	50,479	55,524	59,332	63,995	65,866
White	41,130	46,448	50,542	53,567	57,659	59,984
Black	650	1,032	1,325	1,469	1,723	1,774
Asian	1,511	2,279	2,952	3,093	3,787	3,529
Other	1,617	720	705	1,203	826	579
Total engineers	45,050	50,342	57,039	61,545	65,853	67,768
White	38,619	41,957	47,211	49,733	52,599	53,894
Black	121	102	270	410	513	655
Asian	5,046	7,875	9,022	10,481	11,882	12,752
Other	1,264	408	536	921	859	467
Astronautical/aeronautical	1,987	2,364	2,519	3,684	3,827	5,005
White	1,793	2,122	2,232	3,128	3,295	4,092
Black	0	2	10	21	27	34
Asian	138	232	269	482	503	869
Other	56	8	8	53	2	10

Table B-11. - Continued

Field and racial/ethnic groups	1977	1979	1981	1983	1985	1987
Chemical	5,603	6,166	7,146	6,992	7,122	6,923
White	4,674	4,953	5,553	5,384	5,130	4,988
Black	12	10	37	13	66	72
Asian	721	1,200	1,554	1,502	1,923	1,814
Other	196	3	2	93	3	49
Civil	4,066	5,157	6,089	5,317	6,396	6,479
White	3,255	3,875	4,785	4,190	5,063	5,182
Black	5	1	24	24	85	23
Asian	718	1,204	1,226	1,059	1,182	1,254
Other	88	77	54	44	66	20
Electrical/electronics	8,284	8,597	10,630	12,696	14,248	12,601
White	7,229	7,252	8,931	10,310	11,386	9,744
Black	45	15	40	75	90	209
Asian	833	1,272	1,552	2,093	2,553	2,525
Other	177	58	107	218	219	123
Mechanical	4,648	5,245	5,370	5,657	6,594	6,711
White	3,793	4,057	4,313	4,382	5,069	5,124
Black	5	22	10	91	81	127
Asian	771	1,165	1,045	1,157	1,354	1,412
Other	79	1	2	27	90	48
Other engineers	20,462	22,813	25,285	27,199	27,666	30,049
White	17,875	19,698	21,397	22,339	22,656	24,764
Black	54	52	149	186	164	190
Asian	1,865	2,802	3,376	4,188	4,367	4,878
Other	668	261	363	486	479	217

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-12. Employment status of Hispanic 1/ scientists and engineers by field: 1982-88 /2

	Total employed				Employed in science/engineering jobs			
Field	1982	1984	1986	1988 2/	1982	1984	1986	1988 2/
Total scientists and engineers.....	70,000	86,600	93,400	95,900	58,400	69,500	74,900	NA
Total scientists..................	28,100	38,800	46,100	43,800	20,300	26,400	31,200	NA
Physical scientists..............	3,600	4,300	4,800	5,200	3,000	3,900	4,600	NA
Mathematical scientists..........	1,400	2,700	3,100	3,900	1,300	2,600	2,600	NA
Computer specialists.............	4,600	8,200	9,300	8,700	3,300	5,400	6,100	NA
Environmental scientists.........	1,400	1,800	1,800	2,100	1,300	1,800	1,600	NA
Life scientists..................	6,700	7,300	9,900	10,100	5,200	5,700	7,100	NA
Psychologists....................	2,300	4,200	5,900	4,700	1,200	1,300	2,700	NA
Social scientists................	8,000	10,200	11,400	9,000	5,000	5,600	6,600	NA
Total engineers...................	41,900	47,800	47,200	52,100	38,000	43,100	43,700	NA
Astronautical/aeronautical.......	1,600	1,300	1,500	1,400	1,300	1,000	1,400	NA
Chemical.........................	3,000	2,900	2,700	2,600	2,500	2,800	2,500	NA
Civil............................	8,000	8,100	7,300	7,100	7,600	7,500	7,100	NA
Electrical/electronics...........	9,000	11,300	12,200	13,600	8,600	10,200	11,400	NA
Industrial.......................	2,700	3,400	2,500	3,400	2,300	2,800	2,300	NA
Materials........................	300	100	400	800	300	100	400	NA
Mechanical.......................	7,000	9,200	9,000	8,500	6,200	7,700	7,900	NA
Mining...........................	100	100	100	200	100	100	100	NA
Nuclear..........................	200	100	100	100	200	100	100	NA
Petroleum........................	900	1,000	700	800	800	1,000	700	NA
Other engineers..................	9,200	10,400	10,700	13,600	8,000	9,900	9,900	NA

1/ Data includes members of all racial groups.
2/ 1988 data are model generated rather than survey generated estimates and therefore trends (especially short term) should be treated with caution.

NOTE: Because of rounding, components may not add to totals. NA = Not Available.

SOURCE: National Science Foundation, SRS.

Table B-13. Employment status of Hispanic 1/ doctoral scientists and engineers by field: 1981-87

	Total employed				Employed in science/engineering			
Field	1981	1983	1985	1987	1981	1983	1985	1987
Total scientists and engineers...	4,847	5,428	5,897	6,949	NA	4,689	5,386	NA
Total scientists.................	4,057	4,466	5,115	5,865	NA	3,968	4,740	NA
Physical scientists............	854	884	943	1,027	NA	760	922	NA
Mathematical scientists........	213	198	264	266	NA	192	264	NA
Computer specialists...........	115	232	226	329	NA	232	226	NA
Environmental scientists.......	173	208	250	287	NA	194	224	NA
Life scientists................	1,241	1,267	1,382	1,562	NA	1,177	1,345	NA
Psychologists..................	630	703	976	1,016	NA	612	871	NA
Social scientists..............	831	974	1,074	1,378	NA	801	888	NA
Total engineers..................	790	962	782	1,084	NA	721	646	NA
Astronautical/aeronautical.....	6	3	18	22	NA	3	18	NA
Chemical.......................	24	114	68	102	NA	108	65	NA
Civil..........................	103	72	80	112	NA	72	80	NA
Electrical/electronics.........	83	216	172	117	NA	118	153	NA
Materials......................	187	170	65	110	NA	167	63	NA
Mechanical.....................	33	78	62	69	NA	78	62	NA
Nuclear........................	8	9	17	19	NA	9	17	NA
Systems design engineers.......	111	149	163	206	NA	47	51	NA
Other engineers................	235	151	137	327	NA	119	137	NA

1/ Data includes members of all racial groups.

NOTE: Because of rounding, components may not add to totals. NA = Not Available.

SOURCE: National Science Foundation, SRS.

Table B-14. Selected employment characteristics of scientists and engineers by field, gender, and racial/ethnic group: 1986

Field and racial/ethnic group	Labor force participation rate			Unemployment rate			Science/engineering employment rate			Science/engineering underemployment rate			Science/engineering underutilization rate		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
	Percent														
Total scientists & engineers 1/	94.5	94.6	93.9	1.5	1.3	2.7	84.7	86.4	75.3	2.6	1.9	6.3	4.1	3.2	8.9
White	94.3	94.4	93.8	1.5	1.3	2.6	84.9	86.4	75.9	2.5	1.9	6.1	3.9	3.1	8.5
Black	97.2	97.6	96.4	3.8	2.8	6.0	76.5	79.1	70.2	5.5	3.7	9.7	9.1	6.4	15.2
Asian	96.3	97.0	93.1	1.8	1.9	1.6	87.7	90.7	72.0	2.2	1.8	4.1	3.9	3.6	5.6
Native American	96.0	95.9	96.8	1.2	1.3	3/	79.3	80.5	69.4	2.4	1.1	13.1	3.6	2.4	13.1
Hispanic 2/	95.2	96.1	92.2	2.1	2.2	1.7	80.2	83.8	66.5	4.8	2.5	13.4	6.7	4.6	14.8
Total scientists	95.3	95.9	94.0	1.9	1.6	2.7	76.7	78.3	72.3	4.3	3.3	7.0	6.1	4.8	9.5
White	95.2	95.8	93.8	1.8	1.5	2.6	77.1	78.6	73.0	4.2	3.3	6.7	5.9	4.7	9.1
Black	97.0	97.2	96.7	3.7	1.6	6.5	68.7	69.7	67.2	7.5	5.2	10.8	10.9	6.7	16.7
Asian	96.1	97.5	93.2	2.3	2.8	1.1	76.9	81.7	66.3	3.5	3.0	4.6	5.8	5.8	5.7
Native American	96.6	96.7	96.4	2.1	2.7	3/	68.2	68.5	67.3	5.0	2.1	14.7	7.0	4.8	14.7
Hispanic 2/	94.9	96.5	91.9	3.0	3.8	1.4	67.5	71.0	61.2	8.2	4.0	15.9	10.9	7.6	17.0
Physical scientists	93.6	94.1	90.8	1.4	1.2	3.1	91.9	91.8	92.4	1.9	1.6	3.5	3.3	2.8	6.5
White	93.5	94.0	90.2	1.4	1.1	3.1	91.8	91.6	93.4	1.7	1.5	3.0	3.1	2.7	6.0
Black	98.1	98.4	97.6	2.6	2.0	4.2	87.2	89.3	81.8	4.6	3.1	8.5	7.1	5.0	12.3
Asian	93.0	93.5	91.9	1.2	1.3	0.9	94.4	94.8	93.5	2.5	2.2	3.3	3.6	3.4	4.1
Native American	80.7	80.7	3/	3/	3/	3/	100.0	100.0	3/	3/	3/	3/	3/	3/	3/
Hispanic 2/	94.1	97.3	83.1	3.2	1.3	10.7	96.8	96.7	97.4	1.8	1.7	2.6	5.0	3.0	13.0
Mathematical scientists	94.6	95.4	92.6	1.3	0.8	2.7	79.3	81.3	73.8	3.3	2.0	7.1	4.6	2.8	9.6
White	94.2	95.0	92.1	1.3	0.7	2.7	79.0	81.2	73.0	3.1	1.8	6.8	4.3	2.5	9.3
Black	98.4	98.4	98.5	1.2	(3)	3.4	90.0	90.5	89.0	4.2	5.5	1.8	5.4	5.5	5.1
Asian	97.9	98.4	94.8	2.3	2.6	3/	70.3	69.3	77.0	3.9	3.3	7.5	6.1	5.9	7.5
Native American	100.0	100.0	100.0	3/	3/	3/	39.7	66.7	13.8	44.0	3/	86.2	44.0	3/	86.2
Hispanic 2/	97.6	97.7	97.4	0.9	1.4	3/	82.6	92.3	67.0	3.6	1.5	6.9	4.4	2.9	6.9
Computer specialists	98.5	99.4	96.5	0.8	0.6	1.6	77.7	77.2	79.0	2.5	2.5	2.5	3.3	3.0	4.0
White	98.6	99.4	96.6	0.8	0.5	1.6	78.1	77.5	79.7	2.4	2.4	2.2	3.2	3.0	3.8
Black	99.2	100.0	98.0	1.2	0.3	2.7	70.1	69.8	70.6	4.2	2.7	6.6	5.4	3.0	9.2
Asian	97.6	99.3	92.7	0.6	0.5	1.0	76.6	76.9	75.5	2.7	2.5	3.4	3.3	3.0	4.3
Native American	100.0	100.0	100.0	1.9	2.2	3/	52.4	47.8	75.4	3/	3/	3/	1.9	2.2	3/
Hispanic 2/	96.4	100.0	89.3	0.9	1.3	3/	65.7	69.9	56.5	5.5	6.6	3.1	6.3	7.8	3.1
Environmental scientists	94.5	94.8	92.1	4.4	3.9	8.2	87.4	88.6	78.6	5.6	4.8	11.6	9.7	8.5	18.8
White	94.4	94.7	91.9	4.5	4.0	8.4	88.5	89.8	78.5	5.5	4.6	11.7	9.7	8.4	19.1
Black	97.5	97.1	100.0	0.6	0.2	2.8	41.3	31.9	100.0	4.4	5.1	3/	5.0	5.4	2.8
Asian	97.3	97.1	100.0	2.6	2.9	3/	89.6	91.2	71.7	8.8	9.7	3/	11.2	12.2	3/
Native American	93.8	93.0	100.0	(3)	(3)	3/	74.2	77.9	50.0	15.5	10.2	50.0	15.5	10.2	50.0
Hispanic 2/	95.0	94.5	100.0	4.8	5.3	3/	84.5	85.4	76.6	9.0	8.9	9.6	13.3	13.7	9.6
Life scientists	93.0	94.1	90.0	2.1	1.7	3.4	82.7	83.2	81.1	4.7	3.1	9.6	6.7	4.7	12.6
White	92.8	93.9	89.5	2.1	1.6	3.4	82.9	83.1	82.1	4.4	3.1	8.5	6.4	4.7	11.6
Black	98.5	98.8	97.9	3.8	1.4	7.4	80.9	83.4	76.9	7.3	3.4	13.7	10.9	4.8	20.1
Asian	94.0	96.1	90.7	2.6	2.1	3.3	85.7	90.4	77.6	7.5	3.2	14.7	9.9	5.2	17.5
Native American	100.0	100.0	100.0	3/	3/	3/	63.3	75.3	41.5	0.7	3/	2.0	0.7	3/	2.0
Hispanic 2/	92.2	94.2	89.5	0.8	1.3	3/	71.3	74.6	66.5	16.2	5.7	31.5	16.9	6.9	31.5

Table B-14. - Continued

Field and racial/ethnic group	Labor force participation rate			Unemployment rate			Science/engineering employment rate			Science/engineering underemployment rate			Science/engineering underutilization rate		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
	Percent														
Psychologists	95.1	94.9	95.3	2.5	2.2	3.0	68.2	71.9	63.6	5.7	4.7	6.8	8.1	6.8	9.6
White	95.0	94.7	95.4	2.3	1.8	3.0	69.1	71.7	65.7	5.8	4.8	7.0	8.0	6.6	9.8
Black	94.5	97.0	93.3	3.6	1.5	4.6	66.6	80.4	59.3	4.9	3/	7.5	8.3	1.5	11.7
Asian	99.0	100.0	98.8	4.3	23.0	3/	28.0	95.2	16.2	3/	3/	3/	4.3	23.0	3/
Native American	100.0	100.0	100.0	8.5	11.2	3/	94.3	92.3	100.0	11.5	3/	44.6	19.1	11.2	44.6
Hispanic 2/	96.1	96.3	95.9	4.3	4.8	3.8	46.3	40.9	51.0	7.1	5.3	8.7	11.1	9.8	12.2
Social scientists	95.4	95.8	94.6	2.4	2.3	2.7	60.7	61.9	58.2	7.2	5.4	11.1	9.4	7.5	13.6
White	95.3	95.8	94.3	2.0	2.0	2.1	61.1	62.3	58.1	6.9	5.2	10.9	8.8	7.1	12.8
Black	95.0	93.7	96.8	6.8	3.4	11.2	53.7	50.8	57.8	13.1	9.8	17.9	19.0	12.8	27.1
Asian	96.1	97.8	92.9	6.4	9.6	3/	68.4	74.7	57.0	3.0	4.3	0.5	9.2	13.5	0.5
Native American	95.0	100.0	81.1	3/	3/	3/	49.0	34.0	100.0	7.5	9.7	3/	7.5	9.7	3/
Hispanic 2/	95.0	95.6	93.8	5.8	8.7	3/	57.6	57.9	56.9	7.7	0.6	20.9	13.1	9.2	20.9
Total engineers	93.8	93.8	93.6	1.2	1.2	2.5	91.9	91.9	93.5	1.0	1.0	2.3	2.2	2.1	4.8
White	93.5	93.5	93.5	1.2	1.1	2.5	91.8	91.7	93.5	1.0	0.9	2.4	2.1	2.0	4.9
Black	97.7	98.0	94.8	4.0	4.2	2.0	90.3	90.2	90.9	2.0	1.9	2.3	5.8	6.0	4.3
Asian	96.5	96.7	93.0	1.5	1.4	3.7	95.4	95.4	94.7	1.2	1.1	1.9	2.7	2.5	5.5
Native American	95.6	95.5	100.0	0.4	0.4	3/	87.8	87.8	87.5	0.4	0.5	3/	0.9	0.9	3/
Hispanic 2/	95.6	95.8	93.4	1.2	1.0	3.2	92.6	92.5	93.5	1.4	1.5	0.8	2.6	2.5	4.0
Aeronautical/astronautical	94.7	94.5	98.7	0.4	0.4	1.3	94.3	94.4	91.1	0.6	0.5	3.5	1.0	0.9	4.8
White	94.3	94.1	98.6	0.5	0.4	1.4	94.2	94.3	91.0	0.4	0.3	3.1	0.9	0.7	4.5
Black	100.0	100.0	100.0	3/	3/	3/	86.4	87.3	75.7	7.6	6.3	24.3	7.6	6.3	24.3
Asian	99.6	99.6	100.0	3/	3/	3/	98.2	98.1	100.0	0.8	0.8	3/	0.8	0.8	3/
Native American	86.7	86.7	3/	3/	3/	3/	100.0	100.0	3/	3/	3/	3/	3/	3/	3/
Hispanic 2/	100.0	100.0	100.0	3/	3/	3/	92.9	92.5	100.0	6.0	6.4	3/	6.0	6.4	3/
Chemical	89.1	89.1	89.8	2.6	2.5	4.0	88.2	87.9	92.3	1.9	1.8	3.2	4.5	4.3	7.1
White	88.6	88.6	89.1	2.6	2.5	3.6	89.1	88.7	94.1	1.8	1.8	2.3	4.3	4.2	5.8
Black	99.0	100.0	94.3	1.9	0.9	6.6	43.6	40.7	59.0	6.2	3.4	21.0	8.0	4.3	26.2
Asian	95.8	96.1	93.5	4.2	3.7	8.6	91.3	91.9	86.3	1.7	1.4	4.2	5.9	5.1	12.5
Native American	74.9	74.1	100.0	3/	3/	3/	10.9	7.1	100.0	6.8	7.1	3/	6.8	7.1	3/
Hispanic 2/	99.7	99.6	100.0	6.8	7.7	2.2	92.0	93.8	83.7	0.6	0.7	3/	7.3	8.4	3/
Civil	92.3	92.2	95.0	1.7	1.6	3.6	92.1	92.1	92.4	1.2	1.0	6.3	2.9	2.6	9.7
White	92.1	92.0	94.7	1.3	1.3	3.2	92.1	92.1	91.4	1.3	1.0	7.1	2.6	2.3	10.0
Black	98.3	98.6	90.4	17.2	17.7	5.7	91.7	91.3	100.0	1.3	1.2	2.4	18.2	18.6	8.0
Asian	93.3	93.1	97.9	1.3	1.1	6.3	95.2	95.0	100.0	0.7	0.7	3/	1.9	1.8	6.3
Native American	97.9	97.9	3/	3/	3/	3/	95.7	95.7	3/	3/	3/	3/	3/	3/	3/
Hispanic 2/	92.2	92.5	87.9	2.0	0.7	20.9	97.3	97.2	100.0	1.7	1.8	3/	3.6	2.5	20.9
Electrical/electronics	93.5	93.7	90.0	1.1	1.1	1.0	94.1	94.2	93.0	0.8	0.8	0.3	1.8	1.8	1.3
White	93.2	93.3	90.9	1.0	1.0	0.7	94.1	94.1	92.8	0.7	0.8	(3)	1.7	1.8	0.7
Black	96.1	97.5	73.2	3.1	3.3	3/	92.1	91.8	100.0	2.0	2.1	(3)	5.1	5.3	3/
Asian	96.5	97.3	85.5	1.3	1.1	4.5	95.1	95.3	92.7	0.7	0.6	2.8	2.0	1.7	7.1
Native American	94.6	94.6	3/	3/	3/	3/	90.4	90.4	3/	3/	3/	3/	3/	3/	3/
Hispanic 2/	94.5	95.0	84.9	1.4	1.5	3/	93.4	94.0	80.1	0.3	0.3	3/	1.7	1.8	3/

Table B-14. - Continued

Field and racial/ethnic group	Labor force participation rate			Unemployment rate			Science/engineering employment rate			Science/engineering underemployment rate			Science/engineering underutilization rate		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
	Percent														
Industrial	96.1	96.0	97.0	1.1	1.1	1.4	82.2	81.6	91.6	1.2	1.1	3.0	2.3	2.2	4.3
White	95.8	95.8	96.7	1.1	1.1	1.6	81.3	80.8	91.1	1.1	1.0	2.8	2.2	2.1	4.3
Black	100.0	100.0	100.0	1.9	2.4	3/	93.4	91.7	100.0	4.9	6.2	(3)	6.7	8.4	3/
Asian	100.0	100.0	100.0	1.5	1.6	3/	96.5	97.4	81.3	1.1	3/	18.7	2.6	1.6	18.7
Native American	100.0	100.0	100.0	3/	3/	3/	100.0	100.0	100.0	3/	3/	3/	3/	3/	3/
Hispanic 2/	95.0	95.9	74.0	3/	3/	3/	93.1	92.9	100.0	4.0	4.2	3/	4.0	4.2	3/
Materials	94.0	94.1	92.7	1.7	0.7	17.4	88.3	88.1	92.0	0.9	0.9	0.8	2.6	1.6	18.0
White	93.8	93.8	93.2	1.7	0.7	20.5	87.8	87.3	99.0	0.8	0.8	1.0	2.4	1.4	21.3
Black	99.0	100.0	97.1	0.3	0.5	3/	72.4	100.0	16.1	3/	3/	3/	0.3	0.5	3/
Asian	95.6	97.0	77.0	2.3	2.0	6.9	97.1	97.0	100.0	3.4	3.6	(3)	5.6	5.5	6.9
Native American	100.0	100.0	100.0	3/	3/	3/	100.0	100.0	100.0	3/	3/	3/	3/	3/	3/
Hispanic 2/	96.3	93.3	100.0	0.5	1.0	3/	96.1	92.8	100.0	3/	3/	3/	0.5	1.0	3/
Mechanical	91.2	91.1	93.2	1.3	1.3	2.5	92.1	92.0	96.5	1.1	1.1	1.8	2.4	2.4	4.3
White	90.7	90.7	92.5	1.3	1.3	2.5	91.9	91.8	96.6	1.0	1.0	1.9	2.3	2.3	4.3
Black	97.4	97.1	100.0	1.2	0.6	6.4	95.6	95.9	93.0	0.6	0.7	3/	1.8	1.2	6.4
Asian	97.1	97.0	100.0	1.8	1.9	3/	95.3	95.2	100.0	2.5	2.5	3/	4.2	4.3	3/
Native American	100.0	100.0	3/	3/	3/	3/	89.0	89.0	3/	3/	3/	3/	3/	3/	3/
Hispanic 2/	94.7	94.6	100.0	0.2	0.2	-3.0	87.3	87.2	90.3	1.4	1.2	9.7	1.6	1.3	9.7
Mining	93.7	93.6	96.0	2.2	2.2	1.0	86.1	85.6	97.6	1.6	1.6	0.7	3.8	3.8	1.7
White	94.1	94.0	95.7	2.2	2.2	1.0	85.7	85.2	97.4	1.6	1.6	0.8	3.7	3.8	1.8
Black	4.8	4.8	3/	3/	3/	3/	3/	3/	3/	100.0	100.0	3/	100.0	100.0	3/
Asian	97.9	97.9	3/	3/	3/	3/	100.0	100.0	3/	3/	3/	3/	3/	3/	3/
Native American	100.0	100.0	3/	64.3	64.3	3/	100.0	100.0	3/	3/	3/	3/	64.3	64.3	3/
Hispanic 2/	100.0	100.0	100.0	6.9	9.6	3/	100.0	100.0	100.0	3/	3/	3/	6.9	9.6	3/
Nuclear	97.8	98.1	89.0	1.0	1.0	1.4	97.5	97.5	98.1	0.4	0.3	0.5	1.4	1.4	1.8
White	97.7	98.1	88.4	1.0	1.0	0.8	97.4	97.4	97.9	0.3	0.3	0.5	1.3	1.3	1.4
Black	98.9	98.8	100.0	1.4	3/	17.2	100.0	100.0	100.0	3/	3/	3/	1.4	3/	17.2
Asian	98.7	98.9	76.9	0.5	0.5	3/	99.2	99.2	100.0	0.6	0.6	3/	1.1	1.1	3/
Native American	100.0	100.0	3/	3/	3/	3/	100.0	100.0	3/	3/	3/	3/	3/	3/	3/
Hispanic 2/	95.7	100.0	81.0	2.2	2.7	3/	85.2	81.7	100.0	2.3	2.8	3/	4.4	5.5	3/
Petroleum	95.3	95.3	95.2	3.4	3.2	6.9	92.9	93.5	84.6	2.0	1.9	4.4	5.4	5.0	11.0
White	95.6	95.6	96.0	3.0	2.7	7.6	92.7	93.0	86.4	2.2	2.0	5.0	5.1	4.6	12.2
Black	98.2	98.1	100.0	5.5	5.9	3/	92.2	100.0	3/	3/	3/	3/	5.5	5.9	3/
Asian	72.5	68.5	83.3	5.5	7.9	3/	90.1	100.0	70.0	3/	3/	3/	5.5	7.9	3/
Native American	92.0	91.9	100.0	3/	3/	3/	100.0	100.0	100.0	3/	3/	3/	3/	3/	3/
Hispanic 2/	87.1	85.9	100.0	1.4	1.6	3/	98.7	98.6	100.0	1.3	1.4	3/	2.7	3.0	3/

Table B-14. - Continued

Field and racial/ethnic group	Labor force participation rate			Unemployment rate			Science/engineering employment rate			Science/engineering underemployment rate			Science/engineering underutilization rate		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
	Percent														
Other engineers..................	98.3	98.4	96.4	0.7	0.6	0.8	92.7	92.6	95.0	0.8	0.8	1.5	1.5	1.4	2.4
White...........................	98.2	98.3	96.0	0.6	0.5	0.9	92.4	92.4	94.2	0.8	0.8	1.8	1.4	1.3	2.7
Black...........................	99.2	99.0	100.0	0.4	0.5	3/	93.7	92.3	100.0	0.9	1.1	3/	1.3	1.6	3/
Asian...........................	99.2	99.3	98.2	0.7	0.6	1.2	96.5	96.3	98.7	0.8	0.9	3/	1.5	1.5	1.2
Native American.................	100.0	100.0	100.0	1.6	1.7	3/	94.4	95.4	72.9	3/	3/	3/	1.6	1.7	3/
Hispanic 2/.....................	99.1	99.5	95.8	0.0	0.0	3/	92.3	91.4	100.0	1.6	1.7	3/	1.6	1.8	3/

1/ Detail will not average to total because racial and ethnic categories are not mutually exclusive and total employed includes other and no report.

2/ Includes members of all racial groups.

3/ Too few cases to estimate.

SOURCE: National Science Foundation, SRS.

Table B-15. Average monthly salary offers to bachelor's-degree candidates in selected fields: 1977/78 - 1988/89

Curriculum	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
Business..............	NA	$1,153	$1,250	$1,380	$1,503	$1,518	$1,583	$1,655	$1,725	$1,778	$1,926	$2,033
Humanities............	871	983	1,074	1,204	1,283	1,380	1,477	1,461	1,608	1,688	1,655	1,778
Social sciences.......	930	1,020	1,131	1,246	1,391	1,432	1,537	1,615	1,762	1,894	1,942	1,983
Engineering:												
Chemical............	1,513	1,642	1,801	2,030	2,256	2,228	2,285	2,369	2,438	2,487	2,584	2,746
Civil...............	1,288	1,402	1,554	1,775	1,925	1,869	1,897	1,969	2,011	2,037	2,119	2,228
Electrical..........	1,367	1,520	1,690	1,882	2,064	2,128	2,217	2,283	2,364	2,410	2,474	2,555
Mechanical..........	1,404	1,536	1,703	1,908	2,098	2,096	2,190	2,259	2,322	2,359	2,451	2,545
Petroleum...........	1,653	1,793	1,987	2,221	2,539	2,568	2,464	2,583	2,750	2,568	2,672	2,749
Agricultural sciences.	965	1,046	1,192	1,287	1,391	1,375	1,418	1,474	1,597	1,649	1,686	1,808
Biological sciences...	1,036	1,017	1,159	1,268	1,375	1,419	1,402	1,433	1,589	1,818	1,754	1,750
Chemistry.............	1,191	1,332	1,459	1,637	1,751	1,712	1,756	1,897	1,948	2,131	2,192	2,225
Computer sciences.....	1,266	1,401	1,558	1,726	1,908	1,941	2,046	2,082	2,216	2,197	2,276	2,353
Mathematics...........	1,185	1,324	1,475	1,624	1,777	1,799	1,950	2,047	2,037	2,162	2,237	2,232

SOURCE: CPS Salary Survey, Formal Report (Bethlehem, Pa.: College Placement Council), annual series

Table B-16. Number of job offers to bachelor's-degree candidates in selected fields: 1977/78 - 1988/89

Curriculum	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
Business..............	NA	16,229	15,432	14,011	14,139	10,347	12,385	12,219	10,951	9,642	9,699	9,192
Humanities............	1,010	658	581	675	651	715	760	686	660	854	288	300
Social sciences.......	2,008	1,947	1,783	1,629	1,517	1,387	1,748	1,820	1,540	1,441	1,226	2,635
Engineering:												
Chemical............	5,293	6,310	7,029	7,428	3,986	1,156	2,096	2,263	1,422	1,070	1,139	1,760
Civil...............	3,529	4,424	4,181	4,416	2,326	892	1,164	1,383	1,299	817	894	1,085
Electrical..........	8,599	10,742	11,120	10,768	9,976	8,285	10,330	10,969	6,963	4,527	3,920	3,279
Mechanical..........	8,082	10,030	10,637	10,673	7,338	3,883	4,959	5,815	3,552	2,460	2,466	3,037
Petroleum...........	663	717	762	1,445	1,090	307	415	422	333	60	154	117
Agricultural sciences.	657	257	551	490	469	297	339	246	161	124	135	162
Biological sciences...	313	244	222	215	169	149	120	145	73	73	74	69
Chemistry.............	340	379	427	409	262	147	193	169	149	36	67	133
Computer sciences.....	1,803	2,268	2,569	2,876	3,227	2,572	3,773	3,796	2,644	1,894	1,389	1,702
Mathematics...........	679	756	823	729	708	517	533	565	413	352	304	245

SOURCE: CPS Salary Survey, Formal Report (Bethlehem, Pa.: College Placement Council), annual series

Table B-17. High technology recruitment: 1961-89

Year	Index
	(1961 = 100)
1961	100
1962	120
1963	98
1964	88
1965	132
1966	159
1967	124
1968	98
1969	86
1970	60
1971	44
1972	63
1973	97
1974	101
1975	69
1976	88
1977	115
1978	140
1979	145
1980	139
1981	136
1982	104
1983	102
1984	134
1985	113
1986	109
1987	117
1988	113
1989 1/	103

1/ Second quarter data.

SOURCE: National Science Foundation, SRS, and Deutsch, Shea, and Evans, High Technology Recruitment Index Year End Review and Forecast, (New York, 1983), and unpublished data

Table B-18. Total and scientist/engineer employment by industry: 1980, 1988, and projected to 2000

Industry	Number of Jobs					Annual rate of change	
			Projected 2000				
	1980	1988	Low	Mid	High	1980-88	1988-2000 1/
	(Thousands)					(Percent)	
Total private:							
All occupations	65,812	77,102	78,624	83,655	88,808	2.0	0.7
All science/engineering	1,366	1,858	2,305	2,483	2,650	3.9	2.4
Engineers	992	1,275	1,535	1,659	1,774	3.2	2.2
Aeronautical/astronautical	27	65	88	95	100	11.6	3.2
Chemical	45	45	48	52	55	0.0	1.1
Civil	79	101	106	114	122	3.1	1.0
Electrical/electronics	273	413	532	575	616	5.3	2.8
Industrial	133	125	152	165	177	-0.8	2.3
Mechanical	198	208	251	271	290	0.6	2.2
Other 2/	237	318	360	388	414	3.7	1.7
Scientists	374	583	770	824	875	5.7	2.9
Life	19	34	35	37	39	7.5	0.9
Mathematical	45	81	102	109	117	7.5	2.5
Physical	108	121	117	125	130	1.4	0.2
Social	26	27	32	35	36	0.3	2.3
Computer specialists	175	321	484	518	552	7.9	4.1
Goods-producing:							
All occupations	25,658	25,250	23,412	25,159	26,865	-0.2	0.0
All science/engineering	852	1,054	1,220	1,325	1,419	2.7	1.9
Engineers	686	829	980	1,066	1,142	2.4	2.1
Aeronautical/astronautical	23	56	76	83	87	11.9	3.2
Chemical	33	36	37	40	43	0.8	1.0
Civil	25	17	16	18	19	-4.9	0.3
Electrical/electronics	168	250	306	334	359	5.1	2.4
Industrial	123	109	131	143	154	-1.5	2.3
Mechanical	137	143	172	187	201	0.5	2.3
Other 2/	176	218	242	262	280	2.7	1.5
Scientists	167	225	240	259	276	3.8	1.2
Life	11	20	20	21	22	7.6	0.5
Mathematical	13	17	18	19	22	3.6	1.0
Physical	86	80	71	75	78	-0.9	-0.6
Social	1	1	2	3	3	8.6	6.3
Computer specialists	56	106	130	141	151	8.3	2.4
Durable goods:							
All occupations	12,187	11,437	10,686	11,643	12,547	-0.8	0.1
All science/engineering	580	797	961	1,051	1,131	4.1	2.3
Engineers	515	683	827	905	972	3.6	2.4
Aeronautical/astronautical	23	56	76	83	87	11.9	3.2
Chemical	6	8	9	10	10	3.6	1.8
Civil	5	7	7	7	8	2.5	0.8
Electrical/electronics	154	239	293	320	344	5.6	2.5
Industrial	107	92	112	123	133	-1.8	2.4
Mechanical	102	114	140	153	165	1.4	2.4
Other 2/	118	167	192	210	226	4.4	1.9
Scientists	65	114	134	147	158	7.4	2.1
Life	1	4	4	4	4	20.7	0.4
Mathematical	10	16	17	18	20	6.8	1.0
Physical	17	14	14	15	16	-2.7	0.7
Social	1	1	1	1	1	3.8	0.9
Computer specialists	36	80	99	109	117	10.3	2.6

Table B-18. - Continued

	Number of Jobs					Annual rate of change	
			Projected 2000				
Industry	1980	1988	Low	Mid	High	1980-88	1988-2000 1/
	(Thousands)					(Percent)	
Non durable goods:							
All occupations	8,098	7,967	7,206	7,624	8,005	-0.2	-0.4
All science/engineering	166	184	200	213	225	1.3	1.2
Engineers	90	97	109	116	122	0.8	1.5
Aeronautical/astronautical	0	0	0	0	0	3/	3/
Chemical	27	27	28	29	31	-0.2	0.9
Civil	1	2	2	2	2	3.2	0.2
Electrical/electronics	5	7	8	9	9	2.9	2.4
Industrial	16	15	17	19	20	-0.6	1.6
Mechanical	24	24	27	29	31	-0.2	1.7
Other 2/	17	23	27	29	30	4.0	2.0
Scientists	75	87	91	97	102	1.9	0.8
Life	10	16	17	17	18	6.4	0.5
Mathematical	3	1	1	1	2	-14.7	1.1
Physical	47	48	46	49	51	0.2	0.1
Social	0	0	0	1	1	3/	3/
Computer specialists	15	22	27	29	31	4.9	2.3
Mining:							
All occupations	1,027	721	572	598	621	-4.3	-1.6
All science/engineering	55	48	33	33	33	-1.6	-3.0
Engineers	29	27	19	19	20	-1.1	-2.5
Aeronautical/astronautical	0	0	0	0	0	3/	3/
Chemical	1	1	0	0	0	6.0	3/
Civil	1	1	1	1	1	2.8	-2.7
Electrical/electronics	2	1	1	1	1	-10.6	-2.4
Industrial	0	1	0	0	0	3/	3/
Mechanical	1	2	1	1	1	2.1	-2.6
Other 2/	24	21	16	16	16	-1.2	-2.5
Scientists	26	22	14	14	14	-2.1	-3.6
Life	0	0	0	0	0	3/	3/
Mathematical	0	0	0	0	0	3/	3/
Physical	21	18	11	11	11	-2.0	-4.2
Social	0	0	1	1	1	3/	3/
Computer specialists	4	3	2	2	2	-3.0	-2.6
Construction:							
All occupations	4,346	5,125	4,948	5,294	5,692	2.1	0.3
All science/engineering	53	25	26	28	30	-8.9	1.1
Engineers	52	24	25	26	28	-9.3	0.8
Aeronautical/astronautical	0	0	0	0	0	3/	3/
Chemical	0	1	1	1	1	3/	0.8
Civil	18	8	7	8	9	-9.9	0.3
Electrical/electronics	7	4	4	5	5	-6.9	1.7
Industrial	0	1	1	1	1	3/	1.2
Mechanical	10	4	4	4	5	-11.3	1.3
Other 2/	17	7	7	8	8	-10.7	0.7
Scientists	1	1	1	2	2	2.4	4.4
Life	0	0	0	0	0	3/	3/
Mathematical	0	0	0	0	0	3/	3/
Physical	0	0	0	0	0	3/	3/
Social	0	0	0	1	1	3/	3/
Computer specialists	1	1	1	2	2	2.4	2.0

Table B-18. - Continued

	Number of Jobs					Annual rate of change	
			Projected 2000				
Industry	1980	1988	Low	Mid	High	1980-88	1988-2000 1/
	(Thousands)					(Percent)	
Services-producing:							
All occupations	40,154	51,852	55,212	58,496	61,944	3.2	1.0
All science/engineering	514	804	1,085	1,158	1,230	5.8	3.1
Engineers	306	446	555	593	632	4.8	2.4
Aeronautical/astronautical	4	9	12	12	13	10.1	2.8
Chemical	12	9	11	11	12	-2.9	1.6
Civil	54	84	90	96	103	5.7	1.1
Electrical/electronics	105	163	226	241	257	5.7	3.3
Industrial	10	16	20	22	23	6.3	2.5
Mechanical	61	65	78	84	89	0.8	2.2
Other 2/	61	100	118	126	134	6.3	2.0
Scientists	207	359	530	565	599	7.1	3.9
Life	8	14	15	16	17	7.3	1.4
Mathematical	32	64	84	89	95	8.8	2.8
Physical	23	41	46	50	52	7.9	1.6
Social	25	25	30	32	34	0.0	2.1
Computer specialists	119	215	354	377	401	7.6	4.8
Communications/transportation/utilities:							
All occupations	5,146	5,548	5,213	5,548	5,904	0.9	0.0
All science/engineering	95	112	124	132	140	2.1	1.4
Engineers	82	79	83	88	93	-0.4	0.9
Aeronautical/astronautical	1	1	1	1	1	-7.6	1.5
Chemical	1	1	1	1	1	1.0	1.2
Civil	5	7	6	7	7	4.4	-0.9
Electrical/electronics	43	39	44	46	49	-1.1	1.4
Industrial	4	5	5	5	6	0.9	0.9
Mechanical	7	6	6	6	6	-3.0	0.5
Other 2/	20	21	21	22	24	0.4	0.5
Scientists	13	32	41	44	46	12.2	2.6
Life	0	1	1	1	1	3/	2.2
Mathematical	1	2	2	2	2	8.3	-0.4
Physical	0	2	2	2	2	3/	-0.7
Social	0	2	2	2	2	3/	1.9
Computer specialists	11	26	35	37	39	10.7	3.1
Trade:							
All occupations	20,310	25,138	25,911	27,551	29,201	2.7	0.8
All science/engineering	66	77	105	114	122	1.9	3.3
Engineers	40	41	55	59	63	0.4	3.0
Aeronautical/astronautical	0	0	0	0	0	3/	3/
Chemical	3	1	1	1	1	-10.8	1.9
Civil	0	0	0	0	0	3/	3/
Electrical/electronics	16	16	22	23	25	-0.2	3.3
Industrial	0	0	0	0	0	3/	3/
Mechanical	18	12	16	17	18	-4.7	2.8
Other 2/	3	12	16	17	18	17.3	2.8
Scientists	26	36	51	55	59	4.0	3.6
Life	0	2	2	2	3	3/	1.6
Mathematical	0	0	0	0	0	3/	3/
Physical	1	3	3	3	3	16.8	1.3
Social	0	0	0	1	1	3/	3/
Computer specialists	25	32	46	49	53	2.9	3.8

Table B-18. - Continued

Industry	Number of Jobs 1980	 1988	Projected 2000 Low	 Mid	 High	Annual rate 1980-88
	(Thousands)					(Perc
Financial services:						
All occupations	5,160	6,676	7,461	7,864	8,339	3.3
All science/engineering	52	122	165	174	185	11.3
Engineers	5	15	20	21	22	13.9
Aeronautical/astronautical	0	0	0	0	0	3/
Chemical	0	0	0	0	0	3/
Civil	0	0	0	0	0	3/
Electrical/electronics	0	0	0	0	0	3/
Industrial	0	0	0	0	0	3/
Mechanical	0	0	0	0	0	3/
Other 2/	5	15	20	21	22	13.9
Scientists	46	107	145	154	163	11.0
Life	0	0	0	0	0	3/
Mathematical	16	35	43	45	48	9.9
Physical	0	0	0	0	0	3/
Social	2	7	9	9	10	17.6
Computer specialists	28	65	94	99	105	11.1
Business & related services:						
All occupations	9,538	14,490	16,628	17,533	18,500	5.4
All science/engineering	301	494	691	738	784	6.4
Engineers	179	310	398	426	454	7.1
Aeronautical/astronautical	3	8	11	12	12	13.9
Chemical	9	8	9	9	10	-1.6
Civil	49	77	84	90	96	5.8
Electrical/electronics	46	108	161	172	183	11.3
Industrial	5	11	15	16	17	9.6
Mechanical	35	47	57	61	65	3.5
Other 2/	32	52	62	66	70	6.0
Scientists	122	183	292	312	330	5.3
Life	7	11	12	13	13	5.1
Mathematical	15	27	39	42	45	7.6
Physical	22	37	42	45	47	6.8
Social	23	17	20	21	22	-4.1
Computer specialists	54	92	179	192	204	6.8

1/ As projected in the mid scenario.

2/ The "other" engineering category includes a number of smaller fields which are combined in this report to space limitations. None of these fields individually accounts for more than about 5 percent of the engineering jobs.

3/ Base number is 0 or too small to estimate.

NOTE: Because of rounding, detail may not add to totals. Percentages are calculated from unrounded data. Macroeconomic assumptions for the low, mid and high scenarios are described in appendix table A-5.

The standard industrial classification numbers are:

Goods-producing	
Durable goods	24,25,32-39
Nondurable goods	20-23,26-31
Mining	10-14
Construction	15-17
Services-producing	
Communications/transportation/utilities	40-49
Trade	50-59
Financial services	60-67
Business and related services	70-79,81,83,89

SOURCE: National Science Foundation, SRS.

Table B-19. Bachelor's and first-professional degrees awarded by field: 1960-88

Year	Total Fields	Science/engineering fields						Total other fields 4/
		Total	Physical sciences 1/	Engineering	Mathematical sciences 2/	Life sciences	Social sciences 3/	
1960	394,889	120,937	16,057	37,808	11,437	24,141	31,494	273,952
1961	401,784	121,660	15,500	35,866	13,127	23,900	33,267	280,124
1962	420,485	127,469	15,894	34,735	14,610	25,200	37,030	293,016
1963	450,592	135,964	16,276	33,458	16,128	27,801	42,308	314,628
1964	502,104	153,361	17,527	35,226	18,677	31,611	50,320	348,743
1965	538,930	164,936	17,916	36,795	19,668	34,842	55,715	373,994
1966	555,613	173,471	17,186	35,815	20,182	36,864	63,424	382,142
1967	594,862	187,849	17,794	36,188	21,530	39,408	72,929	407,013
1968	671,591	212,174	19,442	37,614	24,084	43,260	87,774	459,417
1969	769,683	244,519	21,591	41,553	28,263	48,713	104,399	525,164
1970	833,322	264,122	21,551	44,772	29,089	52,129	116,561	569,200
1971	884,386	271,176	21,549	45,387	27,306	51,461	125,473	613,210
1972	937,884	281,228	20,887	46,003	27,250	53,484	133,604	656,656
1973	980,707	295,391	20,809	46,989	27,528	59,486	140,579	685,316
1974	1,008,654	305,062	21,287	43,530	26,570	68,226	145,449	703,592
1975	987,922	294,920	20,896	40,065	23,385	72,710	137,864	693,002
1976	997,504	292,174	21,559	39,114	21,749	77,301	132,451	705,330
1977	993,008	288,543	22,618	41,581	20,729	78,472	125,143	704,465
1978	997,165	288,167	23,175	47,411	19,925	77,138	120,518	708,998
1979	1,000,562	288,625	23,363	53,720	20,670	75,085	115,787	711,937
1980	1,010,777	291,983	23,661	59,240	22,686	71,617	114,779	718,794
1981	1,019,246	294,867	24,175	64,068	26,406	68,086	112,132	724,379
1982	1,036,597	302,118	24,372	67,791	32,139	65,041	112,775	734,479
1983	1,054,242	307,225	23,497	72,954	37,235	63,237	110,302	747,017
1984	1,061,245	314,666	23,759	76,531	45,777	59,613	108,986	746,579
1985	1,066,439	321,739	23,847	77,871	54,388	57,812	107,821	744,700
1986	1,074,785	323,950	21,862	77,061	58,583	56,465	109,979	750,835
1987	1,075,149	318,942	20,155	74,705	56,553	56,215	111,314	756,207
1988	1,076,448	308,760	17,817	70,406	51,018	54,280	115,239	767,688
	As a percent of fields							
1960	100.0	30.6	4.1	9.6	2.9	6.1	8.0	69.4
1961	100.0	30.3	3.9	8.9	3.3	5.9	8.3	69.7
1962	100.0	30.3	3.8	8.3	3.5	6.0	8.8	69.7
1963	100.0	30.2	3.6	7.4	3.6	6.2	9.4	69.8
1964	100.0	30.5	3.5	7.0	3.7	6.3	10.0	69.5
1965	100.0	30.6	3.3	6.8	3.6	6.5	10.3	69.4
1966	100.0	31.2	3.1	6.4	3.6	6.6	11.4	68.8
1967	100.0	31.6	3.0	6.1	3.6	6.6	12.3	68.4
1968	100.0	31.6	2.9	5.6	3.6	6.4	13.1	68.4
1969	100.0	31.8	2.8	5.4	3.7	6.3	13.6	68.2
1970	100.0	31.7	2.6	5.4	3.5	6.3	14.0	68.3
1971	100.0	30.7	2.4	5.1	3.1	5.8	14.2	69.3
1972	100.0	30.0	2.2	4.9	2.9	5.7	14.2	70.0
1973	100.0	30.1	2.1	4.8	2.8	6.1	14.3	69.9
1974	100.0	30.2	2.1	4.3	2.6	6.8	14.4	69.8
1975	100.0	29.9	2.1	4.1	2.4	7.4	14.0	70.1
1976	100.0	29.3	2.2	3.9	2.2	7.7	13.3	70.7
1977	100.0	29.1	2.3	4.2	2.1	7.9	12.6	70.9
1978	100.0	28.9	2.3	4.8	2.0	7.7	12.1	71.1
1979	100.0	28.8	2.3	5.4	2.1	7.5	11.6	71.2
1980	100.0	28.9	2.3	5.9	2.2	7.1	11.4	71.1
1981	100.0	28.9	2.4	6.3	2.6	6.7	11.0	71.1
1982	100.0	29.1	2.4	6.5	3.1	6.3	10.9	70.9
1983	100.0	29.1	2.2	6.9	3.5	6.0	10.5	70.9
1984	100.0	29.7	2.2	7.2	4.3	5.6	10.3	70.3
1985	100.0	30.2	2.2	7.3	5.1	5.4	10.1	69.8
1986	100.0	30.1	2.0	7.2	5.5	5.3	10.2	69.9
1987	100.0	29.7	1.9	6.9	5.3	5.2	10.4	70.3
1988	100.0	28.7	1.7	6.5	4.7	5.0	10.7	71.3

1/ Including earth and environmental sciences.

2/ Including statistics and computer specialties.

3/ Excluding history and including psychology.

4/ Includng first-professional degrees such as M.D., D.D.S., D.V.M., and J.D. degrees.

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS; National Center for Education Statistics, Department of Education

Table B-20. Master's degrees awarded by field: 1960-88

		Science/engineering fields						
Year	Total Fields	Total	Physical sciences 1/	Engineering	Mathematical sciences 2/	Life sciences	Social sciences 3/	Total other fields 4/
1960	74,497	20,012	3,387	7,159	1,765	3,751	3,950	54,485
1961	78,269	22,786	3,799	8,178	2,238	4,085	4,486	55,483
1962	84,889	25,146	3,929	8,909	2,680	4,672	4,956	59,743
1963	91,418	27,367	4,132	9,635	3,323	4,718	5,559	64,051
1964	101,122	30,271	4,567	10,827	3,603	5,357	5,917	70,851
1965	112,195	33,835	4,918	12,056	4,294	5,978	6,589	78,360
1966	140,772	38,083	4,992	13,678	5,010	6,666	7,737	102,689
1967	157,892	41,800	5,412	13,885	5,733	7,465	9,305	116,092
1968	177,150	45,425	5,508	15,188	6,081	8,315	10,333	131,725
1969	194,414	48,425	5,911	15,243	6,735	8,809	11,727	145,989
1970	209,387	49,318	5,948	15,597	7,107	8,590	12,076	160,069
1971	231,486	50,624	6,386	16,347	6,789	8,320	12,782	180,862
1972	252,774	53,567	6,307	16,802	7,186	8,914	14,358	199,207
1973	264,525	54,234	6,274	16,758	7,146	9,080	14,976	210,291
1974	278,259	54,175	6,087	15,393	7,116	9,605	15,974	224,084
1975	293,651	53,852	5,830	15,434	6,637	9,618	16,333	239,799
1976	313,001	54,747	5,485	16,170	6,466	9,823	16,803	258,254
1977	318,241	56,731	5,345	16,889	6,496	10,707	17,294	261,510
1978	312,816	56,237	5,576	17,015	6,421	10,711	16,514	256,579
1979	302,075	54,456	5,464	16,193	6,101	10,719	15,979	247,619
1980	299,095	54,391	5,233	16,846	6,515	10,278	15,519	244,704
1981	296,798	54,811	5,300	17,373	6,787	9,731	15,620	241,987
1982	296,580	57,025	5,526	18,594	7,666	9,824	15,415	239,555
1983	290,931	58,868	5,288	19,721	8,160	9,720	15,979	232,063
1984	285,462	59,569	5,568	20,352	8,939	9,330	15,380	225,893
1985	287,210	61,278	5,802	21,206	9,989	8,757	15,524	225,932
1986	289,823	62,526	5,910	21,314	11,241	8,572	15,489	227,297
1987	290,532	63,018	5,638	22,281	11,808	8,831	14,460	227,514
1988	300,901	63,897	5,650	22,891	12,600	8,559	14,197	236,194
				As a percent of fields				
1960	100.0	26.9	4.5	9.6	2.4	5.0	5.3	73.1
1961	100.0	29.1	4.9	10.4	2.9	5.2	5.7	70.9
1962	100.0	29.6	4.6	10.5	3.2	5.5	5.8	70.4
1963	100.0	29.9	4.5	10.5	3.6	5.2	6.1	70.1
1964	100.0	29.9	4.5	10.7	3.6	5.3	5.9	70.1
1965	100.0	30.2	4.4	10.7	3.8	5.3	5.9	69.8
1966	100.0	27.1	3.5	9.7	3.6	4.7	5.5	72.9
1967	100.0	26.5	3.4	8.8	3.6	4.7	5.9	73.5
1968	100.0	25.6	3.1	8.6	3.4	4.7	5.8	74.4
1969	100.0	24.9	3.0	7.8	3.5	4.5	6.0	75.1
1970	100.0	23.6	2.8	7.4	3.4	4.1	5.8	76.4
1971	100.0	21.9	2.8	7.1	2.9	3.6	5.5	78.1
1972	100.0	21.2	2.5	6.6	2.8	3.5	5.7	78.8
1973	100.0	20.5	2.4	6.3	2.7	3.4	5.7	79.5
1974	100.0	19.5	2.2	5.5	2.6	3.5	5.7	80.5
1975	100.0	18.3	2.0	5.3	2.3	3.3	5.6	81.7
1976	100.0	17.5	1.8	5.2	2.1	3.1	5.4	82.5
1977	100.0	17.8	1.7	5.3	2.0	3.4	5.4	82.2
1978	100.0	18.0	1.8	5.4	2.1	3.4	5.3	82.0
1979	100.0	18.0	1.8	5.4	2.0	3.5	5.3	82.0
1980	100.0	18.2	1.7	5.6	2.2	3.4	5.2	81.8
1981	100.0	18.5	1.8	5.9	2.3	3.3	5.3	81.5
1982	100.0	19.2	1.9	6.3	2.6	3.3	5.2	80.8
1983	100.0	20.2	1.8	6.8	2.8	3.3	5.5	79.8
1984	100.0	20.9	2.0	7.1	3.1	3.3	5.4	79.1
1985	100.0	21.3	2.0	7.4	3.5	3.0	5.4	78.7
1986	100.0	21.6	2.0	7.4	3.9	3.0	5.3	78.4
1987	100.0	21.7	1.9	7.7	4.1	3.0	5.0	78.3
1988	100.0	21.2	1.9	7.6	4.2	2.8	4.7	78.5

1/ Including earth and environmental sciences.
2/ Including statistics and computer specialties.
3/ Excluding history and including psychology.
4/ Includng first-professional degrees such as M.D., D.D.S., D.V.M., and J.D. degrees.

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS; National Center for Education Statistics, Department of Education

Table B-21. Doctoral degrees awarded by field: 1960-88

Year	Total Fields	Science/engineering fields						Total other fields 4/
		Total	Physical sciences 1/	Engineering	Mathematical sciences 2/	Life sciences	Social sciences 3/	
1960	9,733	6,263	1,861	794	291	1,660	1,657	3,470
1961	10,413	6,721	1,993	940	332	1,682	1,774	3,692
1962	11,500	7,438	2,097	1,216	388	1,867	1,870	4,062
1963	12,728	8,219	2,427	1,357	483	1,976	1,976	4,509
1964	14,325	9,224	2,527	1,664	588	2,219	2,226	5,101
1965	16,340	10,476	2,865	2,074	685	2,539	2,313	5,864
1966	17,949	11,458	3,059	2,301	769	2,711	2,618	6,491
1967	20,403	12,982	3,503	2,604	830	2,966	3,079	7,421
1968	22,936	14,448	3,681	2,855	971	3,511	3,430	8,488
1969	25,743	16,039	3,935	3,265	1,070	3,815	3,954	9,704
1970	29,498	17,743	4,403	3,434	1,225	4,165	4,516	11,755
1971	31,867	18,949	4,501	3,498	1,238	4,557	5,120	12,918
1972	33,041	19,007	4,257	3,503	1,281	4,454	5,473	14,034
1973	33,755	19,001	4,078	3,364	1,233	4,503	5,793	14,754
1974	33,047	18,313	3,765	3,147	1,211	4,304	5,853	14,734
1975	32,951	18,358	3,710	3,002	1,147	4,402	6,070	14,593
1976	32,946	17,864	3,506	2,834	1,003	4,361	6,124	15,082
1977	31,716	17,416	3,415	2,643	964	4,266	6,099	14,300
1978	30,875	17,048	3,234	2,423	959	4,369	6,038	13,827
1979	31,237	17,245	3,320	2,490	979	4,501	5,927	13,992
1980	31,017	17,199	3,149	2,479	962	4,715	5,873	13,818
1981	31,353	17,633	3,210	2,528	960	4,786	6,123	13,720
1982	31,096	17,630	3,351	2,646	940	4,844	5,820	13,466
1983	31,216	17,976	3,439	2,781	987	4,756	6,000	13,240
1984	31,277	18,107	3,459	2,913	993	4,877	5,841	13,170
1985	31,211	18,323	3,533	3,166	998	4,902	5,701	12,888
1986	31,770	18,859	3,679	3,376	1,128	4,806	5,846	12,911
1987	32,278	19,312	3,840	3,712	1,190	4,813	5,732	12,966
1988	33,456	20,257	4,046	4,190	1,263	5,121	5,615	13,199
	As a percent of fields							
1960	100.0	64.3	19.1	8.2	3.0	17.1	17.0	35.7
1961	100.0	64.5	19.1	9.0	3.2	16.2	17.0	35.5
1962	100.0	64.7	18.2	10.6	3.4	16.2	16.3	35.3
1963	100.0	64.6	19.1	10.7	3.8	15.5	15.5	35.4
1964	100.0	64.4	17.6	11.6	4.1	15.5	15.5	35.6
1965	100.0	64.1	17.5	12.7	4.2	15.5	14.2	35.9
1966	100.0	63.8	17.0	12.8	4.3	15.1	14.6	36.2
1967	100.0	63.6	17.2	12.8	4.1	14.5	15.1	36.4
1968	100.0	63.0	16.0	12.4	4.2	15.3	15.0	37.0
1969	100.0	62.3	15.3	12.7	4.2	14.8	15.4	37.7
1970	100.0	60.1	14.9	11.6	4.2	14.1	15.3	39.9
1971	100.0	59.5	14.1	11.0	3.9	14.3	16.1	40.5
1972	100.0	57.5	12.9	10.6	3.9	13.5	16.6	42.5
1973	100.0	56.3	12.1	10.0	3.7	13.3	17.2	43.7
1974	100.0	55.4	11.4	9.5	3.7	13.0	17.7	44.6
1975	100.0	55.7	11.3	9.1	3.5	13.4	18.4	44.3
1976	100.0	54.2	10.6	8.6	3.0	13.2	18.6	45.8
1977	100.0	54.9	10.8	8.3	3.0	13.5	19.2	45.1
1978	100.0	55.2	10.5	7.8	3.1	14.2	19.6	44.8
1979	100.0	55.2	10.6	8.0	3.1	14.4	19.0	44.8
1980	100.0	55.5	10.2	8.0	3.1	15.2	18.9	44.5
1981	100.0	56.2	10.2	8.1	3.1	15.3	19.5	43.8
1982	100.0	56.7	10.8	8.5	3.0	15.6	18.7	43.3
1983	100.0	57.6	11.0	8.9	3.2	15.2	19.2	42.4
1984	100.0	57.9	11.1	9.3	3.2	15.6	18.7	42.1
1985	100.0	58.7	11.3	10.1	3.2	15.7	18.3	41.3
1986	100.0	59.4	11.6	10.6	3.6	15.1	18.4	40.6
1987	100.0	59.8	11.9	11.5	3.7	14.9	17.8	40.2
1988	100.0	60.5	12.1	12.5	3.8	15.3	16.8	39.5

1/ Including earth and environmental sciences.
2/ Including statistics and computer specialties.
3/ Excluding history and including psychology.
4/ Includng first-professional degrees such as M.D., D.D.S., D.V.M., and J.D. degrees.

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-22. Percent of recent science/engineering (S/E) degree recipients employed in S/E jobs by degree and field: 1976 and 1986

Field	Bachelor's 1976	Bachelor's 1986	Master's 1976	Master's 1986
	Percent			
Total................	44.7	63.8	77.4	84.3
Physical sciences....	58.9	68.0	67.5	85.7
Mathematics..........	45.9	73.6	61.5	89.7
Computer sciences....	90.0	89.2	85.4	90.0
Engineering..........	83.4	89.1	93.1	94.6
Life sciences........	49.7	56.7	75.9	80.6
Social sciences......	20.7	30.5	66.7	55.8

Note: Individuals enrolled full time in graduate school are excluded. Data for 1976 include 1974 and 1975 S/E graduates. Data for 1986 include 1984 and 1985 S/E graduates.

SOURCE: National Science Foundation, SRS.

Table B-23. Number of 1984 and 1985 science/engineering (S/E) degree recipients working as computer specialists in 1986, by field

	Degree			
	Bachelor's		Master's	
Field	1984	1985	1984	1985
	Number			
Total	35,600	41,900	8,000	8,800
Physical sciences	700	200	100	100
Mathematics	3,900	3,600	400	400
Computer sciences	24,200	29,800	6,000	6,800
Engineering	3,700	3,100	1,200	1,100
Environmental sciences	100	100	100	100
Life sciences	400	400	(1)	100
Social sciences	1,900	4,000	200	200
Psychology	600	600	(1)	100

(1) Too few cases to report.

NOTE: Because of rounding, components may not add to totals.

SOURCE: National Science Foundation, SRS.

Table B-24. Selected employment characteristics of recent science/engineering bachelor's and master's degree recipients by field and gender: 1986

Field and gender	Labor force participation rate		Unemployment rate		Science/engineering employment rate	
	Bachelor's	Master's	Bachelor's	Master's	Bachelor's	Master's
Total science/engineering.....	98.1	97.9	3.5	2.1	63.8	84.3
Men.........................	98.6	99.0	3.4	1.7	69.9	86.8
Women.......................	97.2	95.2	3.7	3.2	52.9	77.6
Total sciences................	97.6	97.3	3.9	2.6	52.6	78.6
Men.........................	98.0	98.9	4.0	2.2	56.1	81.1
Women.......................	97.1	94.8	3.9	3.3	48.5	74.5
Physical sciences.............	97.0	96.4	2.0	1.4	68.0	85.7
Men.........................	98.1	99.2	2.0	1.4	71.6	85.7
Women.......................	95.6	2/	2.1	2/	62.8	2/
Chemistry...................	95.3	97.7	2.7	1.3	75.5	90.9
Men.......................	96.1	2/	2.3	2/	78.6	2/
Women.....................	94.6	2/	3.1	2/	72.3	2/
Physics/astronomy...........	98.6	2/	2.4	2/	80.2	2/
Men.......................	100.0	2/	2.8	2/	78.8	2/
Women.....................	2/	2/	2/	2/	2/	2/
Other physical sciences.....	100.0	2/	0.2	2/	39.1	2/
Men.......................	100.0	2/	0.2	2/	46.7	2/
Women.....................	100.0	2/	0.1	2/	29.2	2/
Mathematics/statistics........	98.0	97.6	1.9	1.5	73.6	89.7
Men.........................	98.2	99.4	2.3	1.4	71.4	88.9
Women.......................	97.7	94.5	1.6	1.6	75.7	91.1
Computer science..............	99.7	98.4	2.7	0.4	89.2	90.0
Men.........................	99.6	99.0	2.9	0.3	88.7	89.5
Women.......................	99.8	96.6	2.5	0.9	89.9	91.6
Environmental sciences........	97.9	98.6	4.4	6.1	60.8	92.5
Men.........................	98.0	99.6	4.7	5.8	60.9	93.8
Women.......................	97.6	2/	3.2	2/	60.5	2/
Life sciences.................	95.8	97.4	4.9	4.2	56.7	80.6
Men.........................	96.6	98.8	3.8	4.0	60.7	82.3
Women.......................	94.9	96.0	6.1	4.4	52.6	78.9
Biology.....................	94.7	97.5	6.2	4.0	51.1	77.9
Men.......................	95.0	99.6	4.9	5.0	53.1	76.2
Women.....................	94.5	95.9	7.3	3.2	49.5	79.2
Agricultural sciences.......	98.0	97.2	2.3	4.6	67.8	85.7
Men.......................	99.0	97.8	2.4	2.7	71.2	89.8
Women.....................	96.2	2/	2.2	2/	61.9	2/
Psychology....................	95.6	96.5	5.3	4.4	26.1	67.3
Men.........................	98.5	2/	8.4	2/	28.0	2/
Women.......................	94.3	94.7	3.8	2.9	25.2	69.6
Social sciences...............	98.0	96.0	4.4	3.4	30.5	55.8
Men.........................	97.4	97.8	4.4	2.6	32.8	57.8
Women.......................	98.8	94.0	4.4	4.4	27.5	53.2
Economics...................	100.0	94.2	5.8	3.5	39.6	57.7
Men.......................	100.0	94.7	5.7	2.7	37.9	49.8
Women.....................	100.0	2/	6.1	2/	43.9	2/
Sociology/anthropology......	96.0	94.8	10.9	4.9	31.0	39.6
Men.......................	96.7	2/	10.0	2/	33.2	(2)
Women.....................	95.5	95.0	11.5	7.0	29.4	47.7
Other social sciences.......	97.2	97.4	0.6	2.8	23.5	60.6
Men.......................	94.9	100.0	1.2	3.1	27.4	68.5
Women.....................	100.0	93.7	1/	2.4	19.2	48.9

Table B-24. - Continued

Field and gender	Labor force participation rate		Unemployment rate		Science/engineering employment rate	
	Bachelor's	Master's	Bachelor's	Master's	Bachelor's	Master's
Total engineering.............	99.3	99.0	2.4	1.2	89.1	94.6
Men..........................	99.5	99.1	2.4	1.0	89.3	94.2
Women........................	97.7	97.9	1.9	2.8	88.2	97.6
Aero/astronautical..........	99.1	2/	1.9	2/	86.0	2/
Men.......................	99.0	2/	2.1	2/	87.5	2/
Women.....................	2/	2/	2/	2/	2/	2/
Chemical....................	98.9	99.0	3.2	3.3	85.8	94.8
Men.......................	99.7	98.8	3.4	1.9	86.2	94.7
Women.....................	96.7	2/	2.9	2/	84.8	2/
Civil.......................	99.5	98.5	2.3	1.0	92.7	95.5
Men.......................	99.7	99.0	2.5	0.4	92.1	95.7
Women.....................	97.9	2/	1.1	2/	96.6	2/
Electric/electronics........	99.1	99.7	2.0	1/	91.9	96.8
Men.......................	99.4	99.7	2.1	1/	92.2	96.5
Women.....................	96.2	2/	1.3	2/	89.5	2/
Industrial..................	98.9	99.9	0.4	2.3	87.3	83.3
Men.......................	100.0	2/	0.5	2/	88.8	2/
Women.....................	95.2	2/	(1)	2/	81.8	2/
Materials...................	96.7	2/	2.2	2/	88.9	2/
Men.......................	96.8	2/	1.5	2/	87.5	2/
Women.....................	2/	2/	2/	2/	2/	2/
Mechanical..................	100.0	99.7	2.6	1.3	90.3	96.5
Men.......................	100.0	99.7	2.6	1.4	89.7	96.6
Women.....................	100.0	2/	2.8	2/	95.6	2/
Mining......................	97.5	2/	5.7	2/	81.8	2/
Men.......................	97.0	2/	6.6	2/	83.7	2/
Women.....................	2/	2/	2/	2/	2/	2/
Nuclear.....................	2/	2/	2/	2/	2/	2/
Men.......................	2/	2/	2/	2/	2/	2/
Women.....................	2/	2/	2/	2/	2/	2/
Petroleum...................	100.0	2/	8.5	2/	88.3	2/
Men.......................	100.0	2/	7.2	2/	90.4	2/
Women.....................	2/	2/	2/	2/	2/	2/
Other engineering...........	99.1	97.4	2.2	2.1	81.2	90.4
Men.......................	99.1	97.7	2.5	2.1	80.8	89.2
Women.....................	99.5	2/	0.4	2/	83.8	2/

1/ No unemployment reported.
2/ No rate computed for groups with less than 1,500 in labor force.

NOTE: Combined 1984/1985 graduates, exclusive of full-time graduate students.

SOURCE: National Science Foundation, SRS.

Table B-25. Selected characteristics of physically disabled scientists and engineers: 1986

Field	Total population	Visual	Auditory	Ambulatory	Other
Total scientists and engineers	94,200	21,100	16,500	20,500	36,100
Scientists	40,400	9,700	7,600	9,800	13,400
Physical scientists	7,600	2,500	1,100	1,400	2,600
Mathematical scientists	1,600	300	400	500	500
Computer specialists	9,200	1,800	2,700	3,000	1,700
Environmental scientists	3,000	200	400	1,300	1,100
Life scientists	6,300	1,300	1,200	1,700	2,100
Psychologists	6,100	1,100	1,400	1,200	2,400
Social scientists	6,600	2,600	400	700	2,900
Engineers	53,800	11,400	8,900	10,800	22,700

		Labor force status			
Field	Total population	Labor force	Total employed	Employed in S/E	Unemployed seeking
Total scientists and engineers	94,200	71,400	70,300	63,400	1,100
Scientists	40,400	34,500	34,200	29,400	300
Physical scientists	7,600	5,300	5,300	5,100	(1)
Mathematical scientists	1,600	1,600	1,500	1,300	100
Computer specialists	9,200	9,100	9,100	7,800	(1)
Environmental scientists	3,000	2,000	2,000	1,900	(1)
Life scientists	6,300	5,700	5,600	5,100	100
Psychologists	6,100	5,400	5,400	3,600	(1)
Social scientists	6,600	5,500	5,300	4,500	100
Engineers	53,800	36,900	36,100	34,000	800

(1) Too few cases to estimate.

NOTE: Because of rounding, components may not add to totals. S/E = Science/engineering.

SOURCE: National Science Foundation, SRS.

Table B-26. Selected data on stock and flows of the science/engineering (S/E) workforce by occupational group or field of degree: 1986

	Total scientists and engineers		Natural scientists, engineers and computer specialists		Social and behavioral scientists	
	Number (Thousands)	Percent	Number (Thousands)	Percent	Number (Thousands)	Percent
Status of 1985 S/E employed workers in 1986:						
Total 1985	3,514	100.0	3,136	100.0	378	100.0
Employed in S/E	3,229	91.9	2,875	91.7	354	93.8
Deceased	28	0.8	26	0.8	3	0.7
Unemployed	11	0.3	17	0.5	1/	1/
Emigrated	15	0.4	12	0.4	4	1.0
Employed in non-S/E	132	3.8	119	3.8	13	3.5
Out of workforce	99	2.8	89	2.8	10	2.6
Source of 1986 S/E employed workers:						
Total 1986	3,682	100.0	3,275	100.0	407	100.0
1985 S/E employed carryover to 1986	3,229	87.7	2,875	87.8	354	87.1
Total 1985 S/E graduates	227	6.2	196	6.0	31	7.6
U.S. citizens	210	5.7	180	5.5	30	7.3
Foreign citizens	17	0.5	16	0.5	1	0.3
Re-entrants to S/E employment	172	4.7	152	4.6	20	4.9
Direct immigration	30	0.8	28	0.9	1	0.3
Upgraded workers	24		24		0	
Workforce status of S/E graduates by broad field of study 2/:						
Total	327	100.0	225	100.0	102	100.0
Employed in S/E	210	64.2	180	80.0	30	31.6
Employed in non-S/E	101	30.8	36	15.9	65	68.4
Out of workforce	10	3.0	5	2.2	5	5.3
Unemployed	6	2.0	4	2.0	2	2.1

1/ There was a net reduction of 6 in S/E unemployment.

2/ Excluding full-time graduate students.

Notes: Data are rounded to nearest thousand and percentages are based on unrounded data.
See text footnotes for definitions of methodology and caveats.

SOURCE: National Science Foundation, SRS.

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